A PUBLICATION FOR THE VACUUM COATING INDUSTRY FALL/WINTER 2025

SVC™ SOCIETY of VACUUM COATERS

BULLETIN

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High-Quality and High Deposition Rate Atomic Layer Deposition of NbN and TiN for Superconducting Quantum Applications

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TECHCON PREVIEW* – *69th SVC Technical Conference

April 25 – April 30, 2026 | Long Beach, CA, USA

SVC Society of Vacuum Coaters
BULLETIN
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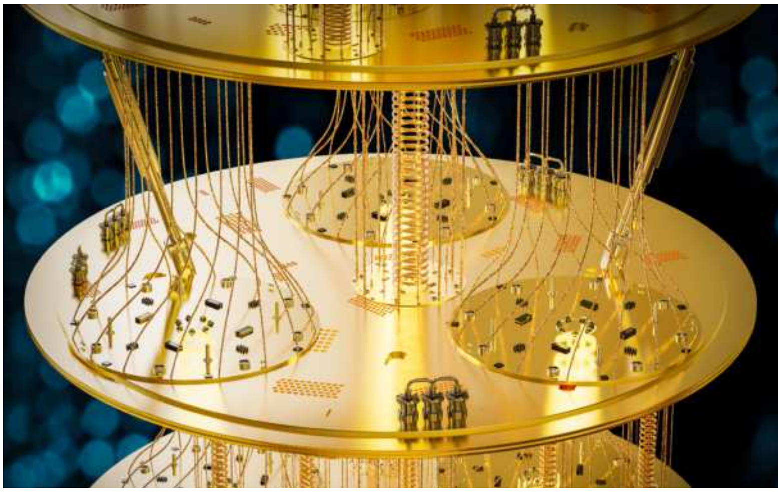

ABOUT THE COVER

A quantum computer is a new type of computer that leverages the principles of quantum mechanics, like superposition and entanglement, to perform calculations using quantum bits or qubits, which can represent more than just 0 or 1 simultaneously. While still in their early stages, quantum computers have the potential to solve certain problems far beyond the capabilities of even the most powerful classical supercomputers, potentially revolutionizing fields like drug discovery, materials science, and cybersecurity.

Cover image courtesy of Shutterstock

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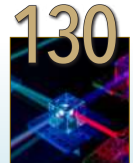

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SVC BULLETIN

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BULLETIN SUBSCRIPTION (FREE)
www.svc.org

SVC welcomes contributed original articles.
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SVC Mission: To promote technical excellence by providing a global forum for networking, educating, and informing the stakeholders, the technical community & the industrial eco-system on all aspects of industrial vacuum coating, surface engineering and related technologies.

SVC Vision: To provide a dynamic global forum for transitioning and commercializing thin film and surface engineering innovation to industry.

The SVC Awards Committee Invites Your Nominations

The SVC Awards Committee is responsible for selecting the recipients of our awards: the **Nathaniel H. Sugerman Award** for distinguished achievement, and the **Fellow-Mentor Award** for significant contributions to the SVC or the vacuum coating industry. We request that nominations be sent to Chris Muratore, University of Dayton, Awards Committee Chair, cmuratore1@udayton.edu, by December 15, 2025. The criteria for the awards and a list of past award recipients can be found on the ***SVC website***.

Nominations should give a brief, thoughtful statement about the individual in light of the criteria for the proposed award. The Sugerman and Mentor Awards can be based on a broad range of possible contributions to the SVC and/or the vacuum coatings industry. Please consider candidates whose contributions are significant but perhaps not as apparent based on more formal mechanisms, i.e., scientific publications.

We encourage you to submit nominations for the 2026 awards now!

Fellow-Mentor Awardees are eligible for the Sugerman Award. Employees and contractors of the SVC and current members of the Awards committee are not eligible.

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LETTER
FROM THE PRESIDENT

Liz Josephson
SVC President
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As the vacuum community wraps up their summer, the SVC is diving headfirst into the planning for 2026 TechCon. All 22 Technical Advisory committees (TAC's) are actively organizing invited and contributed speakers, along with Breakfast & Sunset Forums and colloquiums covering a broad spectrum of vacuum related topics. If you haven't already joined a TAC, your ideas and contributions can shape the conference's content. The topics and targeted speakers are all generated by the TAC leadership and their respective committee members, if you have topics of interest, please bring those to meetings or contact the TAC leaders.

We have rolled out an incentive program for the TAC's which will build on the momentum of bringing new speakers and new attendees to TechCon. If you are interested in learning how you can get discounts on your registration, please contact your TAC Leader.

We will have 4 new TACS in 2026 and we are excited to see what contributions they can bring. As soon as the TAC Leaders are announced, we encourage you to join the TAC most relevant to your interests:

- Photonically-Induced Transformations of Thin Film and Surfaces
- Large Area Packaging and Integrated Surfaces
- Characterization, testing and failure analysis of thins films, coatings and engineered surfaces
- Advanced Multifunctional Coatings: Integrating Vacuum and Electrochemical Deposition for the Sustainable Energy, Surface Protection, and Biomedical Innovations (Joint Session with the Electrochemical Society – ECS).

Our Education program with more than 30 Tutorials, has realigned timing of classes to coincide with feedback that starting on the Saturday before TechCon is a difficult time for many attendees, so we have organized the Education program to be built around the TechCon layout. Don't' forget to take advantage of the Education offerings included in your full TechCon registration.

We look forward to welcoming our new Board members & Vice President after the upcoming election. Participation by the active members on the Board, in the Committees and at the TechCon, is a critical element in forming and driving the content that makes SVC such a valuable organization.

The 2026 Call for Papers has been published and can be found at **www.svctechcon.com**. Please submit your abstract, volunteer for a colloquium or bring ideas to the TACs. The SVC community thrives on your involvement and welcomes all volunteers.

— Liz Josephson
SVC President

Message from the Program Director

At the time of this writing, the TechCon program planning calendar has arrived at the stage where "game plan" development has been completed, and the Program Leadership Team is changing gears towards implementation and execution. The "game plan" period relies on an in-depth analysis of the 2025 TechCon performance, reading the barometer of the economic climate ahead, merging strategic goals into tactical initiatives, and reviewing and implementing "best practices".

The SVC is fortunate to be able to combine an understanding of underlying drivers of "attendee value" with an operational model that allows for nimble execution and creative implementation of innovative program characteristics. For the 2026 program planning cycle, this has resulted in a number of refinements that promise a superior attendee experience in Long Beach:

- 4 additional session topics to extend the range in expertise.
- A significant "review and refresh" of the all-volunteer Program Leadership Team to promote ownership and active participation.
- Enhancing the attendee experience of the TechCon's renowned interactive networking program elements by…
  - hosting an unprecedented number of six in-session Colloquia;
  - expanding the Technology Forum program by adding afternoon "Technology Forum Sunset" blocks to the traditional "Technology Forum Breakfast" (TFB) offerings that allow to host a wider range of topics that attendees can attend more effectively.

Furthermore, we understand that the TechCon experience of our diverse stakeholders extends well beyond the technical program, and covers education and the exhibit. Consequently, the Program Leadership Team coordinates with the Education Program to ensure an optimal match between tutorial offerings and program topics. Program Leadership actively encourages exhibit booth sign-ups, the program schedule promotes and minimally competes with attending the exhibit, and we continue the successful "Exhibitor innovation Session" as an opportunity for our valued exhibitors to pursue their commercial interests by highlighting the value and innovation of their products.

In summary, while we live in a time of uncertainty and a cloudy outlook on the future for many professional societies and conferences, the SVC leaves no idea untested and no opportunity unevaluated to offer our stakeholders the best experience to further their professional and personal goals. I hope the review of the extraordinary technical contributions highlighted in this issue of the Bulletin – most of it sourced from community member contributions to a past TechCon – and the planning and preparation that the all-volunteer Program Leadership Team invests in the 2026 TechCon convinces you to join us in Long Beach next April.

Please consider submitting an abstract to highlight your recent scientific achievements or product innovation, network with colleagues and peers during a Colloquium or Technology Forum get-together, further your technical expertise with a tutorial, or meet with exhibitors to help solve process or equipment challenges. Now is a perfect time for you to commit to attending the most impactful and influential conference in our industry.

I look forward to welcoming you in Long Beach next April!

— Chris Stoessel, PhD, SVC Program Director
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SVC Society of Vacuum Coaters

Our Vision: *To provide a dynamic forum for transitioning and commercializing thin film and surface engineering innovation to industry.*

Our Mission: *To promote technical excellence by providing a global forum for networking, educating, and informing the stakeholders, the technical community, and the industrial eco-system on all aspects of industrial vacuum coating, surface engineering and related technologies.*

Publication Options:

There are two publication options and one video presentation option for work presented during the 2026 Technical Program

WITHOUT PEER REVIEW

Submission Deadline:
September 12, 2026
Publication in PowerPoint OR Manuscript format in Society of Vacuum Coaters Annual Technical Conference Proceedings
(ISSN 0737-5921)

PEER REVIEWED

Submission Window Open
May 1 – September 12, 2026
Publication in a special edition of Elsevier's Surface and Coatings Technology Journal
(ISSN: 0257-8972)

VIDEO PRESENTATIONS

Submission window open
May 1 – September 12, 2026
Narrated mp4 or PowerPoint video to be posted to the SVC's dedicated YouTube Channel

For more information, contact the SVC at +1-505-897-7743 or CLICK HERE to submit an abstract | 2026 TechCon

SVC and SVC Foundation Travel Support for Students and Young Professionals

Young professionals and students are our future. The SVC and the SVC Foundation recognize that capturing the imagination and the interest of young technicians, engineers, and scientists are essential activites that will perpetuate the technologies and the companies that comprise the SVC. Student education scholarships and sponsorships supporting travel and conference participation are offered annually through programs that encompass a global reach to qualified and deserving individuals.

SVC Student/Young Professional Travel Sponsorship Program

The SVC Travel Sponsorship Program provides travel support and complimentary conference registration to selected full-time students and young professionals (under the age of 35 working in industry) to make an oral technical presentation at the SVC Annual Technical Conference. A limited number of sponsorships will be awarded to the best applicants. Applicants from industry, academic, research, and technical institutions from the United States and around the world are encouraged to apply. The Travel Sponsorship Committee evaluates applications and makes selections based on the quality and relevance of the applicant's project to the interests and mission of the SVC. It will also consider the quality of the application itself (completeness, quality, etc.), potential impact of the oral presentation, its relevance to the specific session, as well as the need for funding.

Requirements for Participation:

The applicant must have a sponsor. The sponsor can be a faculty member or supervisor at the student's institution/place of employment or another academic, technical, or research institution. The sponsor must indicate that he or she understands the nature of the conference and what SVC technical programs are about. The applicant must commit to providing a manuscript based on the content of the oral presentation at the TechCon or the PowerPoint presentation delivered at the TechCon for subsequent publication by the SVC before any financial support is provided.

During the selection process, preference will be given to those applicants who have not already received sponsorship from SVC. The successful candidates should also preferably come from different institutions.

SVC Travel Sponsorship Program Abstract and Application Deadline: October 4, 2025

The SVC Foundation provides scholarships and/or stipends for travel expenses to attend the annual SVC technical conference. Scholarships are open to well-qualitified students planning to enter fields related to vacuum coatings as well as techicians already working in the field practicing the craft. The Society of Vacuum Coaters (SVC), the SVCF's founder, and AIMCAL, an organization committed to advancing vacuum roll-coating technology, and their members, provides support for the Foundation to pursue these goals. Since its inception in 2002, the SVCF has awarded more than 220 scholarships and travel awards totalling over $600,000 to students from more than 28 countries.

Please visit www.svcfoundation.org for more information

Academic Scholarship application deadline: October 18, 2025

Industry Scholarship application deadline: January 23, 2026

Student Travel Sponsorship application deadline: October 4, 2025

Call for Papers

Abstract Submission Deadline
Guaranteed Session Placement: January 1, 2026

Advanced Multifunctional Coatings: Integrating Vacuum and Electrochemical Deposition for Sustainable Energy, Surface Protection, and Biomedical Innovations (*Joint Session wwith The Electrochemical Society*)

Thin-film coatings are at the heart of materials innovation, playing a transformative role in energy systems, corrosion resistance, surface protection, and biomedical applications. This session will bridge expertise from the Society of Vacuum Coaters (SVC) and the Electrochemical Society (ECS) by exploring the synergy between vacuum-based deposition techniques and electrochemical processes, focusing on their combined potential for enhancing specific applications. Whether by integrating vapor-phase deposition methods with electrochemical techniques or applying vacuum-deposited thin films directly to electrochemical devices such as batteries, fuel cells, and sensors, the session will highlight how these approaches can drive the development of high-performance, multifunctional materials for a range of applications.

Vapor-phase methods such as physical vapor deposition (PVD), chemical vapor deposition (CVD), and atomic layer deposition (ALD) enable the deposition of high-purity, conformal coatings with precise microstructural control. These techniques are becoming crucial for the fabrication of next-generation energy devices, corrosion and wear-resistant surfaces, and bioactive films. This session aims to explore the dynamic intersection of vacuum-based deposited thin films materials and electrochemical technology applications. By bridging surface engineering with electrochemical performance, the session seeks to promote cross-disciplinary dialogue and drive innovation across both fields. Discussions will focus on how advanced thin films, coatings, and nanostructures fabricated through vacuum processes can transform electrochemical devices such as batteries, fuel cells, sensors, and beyond.

The Session welcomes papers in the following areas:

- Innovations in PVD, CVD, and emerging vacuum methods for fabricating high-performance electrochemical components,
- Integration of vacuum deposition (PVD/CVD) with electrochemical methods (electrodeposition, electroless plating) for multifunctional and durable coatings,
- Design and development of thin film electrodes for batteries, supercapacitors, and fuel cells to enhance energy storage and conversion efficiency,
- Surface modification using vacuum-based techniques to improve interfacial stability, conductivity, and overall electrochemical performance,
- Advances in scalable vacuum deposition processes tailored for mass production of electrochemical energy storage and conversion devices,
- Vacuum-deposited coatings for next-generation batteries, fuel cells, supercapacitors, and hydrogen storage systems, and
- Novel vacuum deposition approaches to enhance corrosion resistance and extend the service life of components in aerospace, marine, and harsh environments.

Session Organizers:

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Chris Stoessel, *Stoessel Consulting,* cstoessel@stoesselconsulting.net

Advances in Thin Film Sensor Technologies: Materials Design and Applications

This technical session highlights cutting-edge developments in thin film sensor technologies, with a focus on the interplay between novel functioning materials, innovative design strategies, and impactful real-world applications. As sensing demands grow across diverse sectors—from healthcare and environmental monitoring to industrial automation and wearable electronics—thin film-based sensors have emerged as a powerful platform for achieving high sensitivity, selectivity, and integration in compact form factors.

Contributions to this session will explore advances in functional thin film materials, including nanostructured, hybrid, and two-dimensional systems; breakthroughs in deposition techniques and micro/nanofabrication; and the engineering of sensor architectures optimized for performance and reliability. Particular emphasis is placed on interdisciplinary approaches that combine materials science, nano-photonics, optoelectronics, electronics, and data-driven techniques to push the limits of sensing performance. Researchers and technologists from academia, industry, and government are encouraged to share innovations, challenges, and future directions in this rapidly evolving field.

The session will welcome contributions on, but not limited to, the following topics:

- Advanced Sensing Materials: Novel nanostructured, hybrid, and 2D thin films,
- Deposition and Fabrication: Innovations in thin film growth and micro/nano-processing,
- Sensor Design and Integration: Compact, robust, and multifunctional architectures,
- Interdisciplinary Approaches: Merging materials, photonics, and electronics,
- Smart Sensing Systems: AI/ML-enhanced data processing and analytics, and
- Application Highlights: Use cases in health, environment, industry, and wearables.

INVITED SPEAKER:

Self-Assembled Oxide-Metal and Nitride-Metal Nanocomposite Thin Films for Metamaterials and Optical Sensing Applications

Di Zhang
University of Texas at Arlington, Arlington, TX

Integration of nanocomposites and heterostructures can create extraordinary properties that cannot be achieved in single phase materials. Beyond oxide-oxide functional nanocomposite films which have been widely explored in the past two decades of this century, oxide-metal nanocomposites films have attracted increasing interests in recent years owing to their wide range of functionalities, such as metamaterials with plasmonic and hyperbolic optical properties, and ferroelectric, ferromagnetic and multiferroic behaviors. In this talk, I will focus on introducing the recently explored oxide-metal and nitride-metal vertically aligned nanocomposite (VAN) thin films showing exotic optical and magnetic-optic coupling effect. Detailed transmission electron microscopy (TEM) and X-ray diffraction (XRD) characterization work revealed the film epitaxy and crystallographic lattice matching relation at metal/oxide (nitride) interfaces. The structure anisotropy of the nanocomposite films results in the corresponding anisotropic optical properties such as angular-dependent transmission and reflectivity, and plasmonic hyperbolic dispersion in the UV-Vis-NIR wavelength regimes. The novel physical properties and coupled functionalities render the VAN thin films to have great potentials in nanophotonic and optical sensing applications.

TAC Co-Chairs:

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Atomic Layer Processing (ALP)

Over the last few years, atomic layer processes (ALPs), such as atomic layer deposition (ALD), atomic layer etching (ALE), molecular layer deposition (MLD), and atomic layer epitaxy (ALEp) have increased in importance, enabling many new products and applications. With excellent uniformity, nanoscale precision, and high versatility, ALPs have applications in sensing, optical coatings, energy storage, and microelectronics. Recent advances in low temperature processing make ALP methods attractive to the processing polymers, biomaterials, and other applications with low thermal budgets.

Sequential Infiltration Synthesis (SIS), alternatively called also Vapor Phase Infiltration (VPI) complements the above-mentioned layer-by-layer technologies by its ability to form 3D nanostructures by a bulk diffusion and selective chemical reactions of precursor with functional groups in polymers or block co-polymers (BCP). Highly selective reactions of precursors with e.g., carbonyl groups (C=O) in the polymer bulk allows integration of inorganic materials into the organic matrix, resulting in a hybrid material. A self-organized BCP film after the SIS will form 3D nanostructures.

The common feature of all those methods is the use of self-limiting reactions that can provide atomic-scale resolution in both vertical and horizontal directions: this property can also be complemented by selectivity in etching or deposition. Selectivity in deposition or etching may solve some of the processing challenges in the technology of nano-devices, e.g., alignment of nanometer-sized features. A high degree of control makes the selective atomic scale processes attractive for future nano-fabrication methods.

We are soliciting oral and poster contributions in areas including both established technologies and creative new developments. Advanced technologies which successfully cross over from early-stage feasibility studying to commercially viable industrial solutions are of particular interest.

Session topics will include:

- Innovations in methods for upscaling ALPs towards high-volume industrial applications,

- New business concepts or market perspectives that accelerate transfer of ALPs and selective atomic processes from the lab to commercial viability,
- Current commercial products using ALPs,
- Precursor synthesis,
- Fundamental aspects of ALP,
- Process development,
- Plasma enhanced processes,
- Challenges and applications of ALPs and selective atomic processes,
- Novel concepts for ALP process control, characterization, and monitoring,
- Applications of selective atomic processes, and
- Selective atomic processes in micro- and nanoelectronics.

Directional Atomic Layer Etching of Lithium Niobate Using Bromine Plasma Chemistry

Austin Minnich
California Institute of Technology, Pasadena, CA

Lithium niobate ($LiNbO_3$, LN) is a ferroelectric crystal of interest for integrated photonics owing to its large second-order optical nonlinearity and the ability to impart periodic poling via an external electric field. However, on-chip device performance based on thin-film lithium niobate (TFLN) is presently limited by propagation losses arising from surface roughness and corrugations. Atomic layer etching (ALE) could potentially smooth these features and thereby increase photonic performance. Previously, our group has reported the first isotropic ALE processes for lithium niobate. Here, we report a directional ALE process for x-cut MgO-doped LN using an HBr-containing plasma. At 0 degrees Celsius we report an 85% synergy ALE recipe with etch rate of 1.04 nm/cycle and surface roughening. At 200 degrees Celsius we report a reduced synergy at 30%, with an etch rate of 1.24 nm/cycle and no evidence of surface roughening. We also compare the surface roughness result of the HBr containing process with a chlorine-only process. Our ALE process could be to fabricate waveguide structures with nanometer precision without surface roughening or redeposition, thereby increasing the performance of TFLN nanophotonic devices and enabling new integrated photonic device capabilities.

TAC Co-Chairs:

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Characterization, Testing, and Failure Analysis of Thin Films, Coatings, and Engineered Surfaces

In support of innovations and continuous R&D, product and process improvements across SVC society stake holders and industries, a new session for the SVC TechCon has been added to this year's program. This new session focuses on thin film, coating, and engineered surface characterization, evaluation and failure analysis. The goal of the session is to provide a forum for attendees to present and exchange technical information related to characterization and evaluation of thin films, coatings and engineered surfaces made through vacuum coating processes. The importance and significance of this session are obvious. First, the various properties of thin films and coatings depend on several factors during preparation. Proper characterization is critical for understanding and further optimization. Second, characterization and testing are essential for intended applications, for meeting product-design specifications, and for ensuring desired interactions with service environments. Third, the lifetime estimates, and failure analysis of thin films and coatings are crucial for avoiding unexpected situations and for identifying root causes of failures.

There are a variety of techniques for analysis, characterization and testing of materials. This session will focus on techniques and applications suitable for thin films, coating and engineered surfaces, with an emphasis on the recent development of the new in-situ and ex-situ capabilities, multi-technique approaches, automation, and AI assistance.

Presentation submissions in the following areas and topics are encouraged:

- Biological compatibility, toxicity, antimicrobial properties,
- Chemical composition, stability and interactions with environments,
- Lifetime estimation and life cycle assessment,
- Mechanical properties, super-hardness and stress evolution,
- Electric and magnetic properties,
- Microstructure, crystallinity, phase composition and porosity

- Nano/microscale phenomena, organized structures and nano-composites,
- Optical properties, colors and emissivity,
- Surface and interfacial properties,
- Thermal properties, heat transfer and thermal stability, and
- Tribological properties, wear and adhesion.

This session, through a series of invited talks and contributed presentations, aims to address common questions and challenges faced by researchers, practitioners, and professionals who are in the SVC associated fields. It will provide new insights into the analysis, characterization and testing methods currently available, recently developed and under development for thin films, coatings and engineered surfaces.

INVITED SPEAKERS:

New Developments in Spectroscopic Ellipsometry

James N. Hilfiker, Nina Hong, Rafał Korlacki, Jeffrey S. Hale, Joel Mohrmann, Jeremy Van Derslice

J.A. Woollam Company, Lincoln, NE

For decades, spectroscopic ellipsometry (SE) has been a prominent technique for non-destructive and accurate measurement of thin film thicknesses and optical constants. To understand recent advances, we first need to consider the conventional SE measurement technology. Most SE tools probe the sample of interest using light with wavelengths from the ultraviolet (UV) to the near-infrared (NIR) or even the mid-infrared (IR). SE data are often collected in seconds. The data analysis has become routine for the thickness and refractive index of single-layer coatings, and with some effort, can be extended to more complex structures. Now, let's examine several new advances in instrumentation and software that are enhancing SE capabilities.

While SE performed at UV to NIR wavelengths is fast, SE measurements in the mid-IR can take hours to achieve an adequate signal-to-noise ratio. Recently, quantum cascade lasers (QCL), with many orders of magnitude more brightness than standard blackbody radiation sources, have been integrated into IR-SE. The extra light allows much faster measurements, which is particularly useful for dynamic data collection, anisotropic characterization requiring multiple sample orientations, and uniformity mapping.

Standard SE measurements describe the transformation of polarized light by the sample. A more complete description of light is considered by the Stokes-Mueller formalism. With this capability, both the cross-polarization and depolarization of light can be quantified. One such example is $LiNbO_3$, used in photonic applications, where the uniaxially anisotropic refractive index can be determined via sample-rotated Mueller matrix (MM) SE measurements. MM-SE is also used for chiral materials and non-symmetric crystal materials. MM-SE measurements have even found applications in many semiconductor processing steps, where critical dimensions (CD) can be determined via the specular scatter measured by MM-SE for 3D memory and logic device structures.

Finally, we will examine how machine learning is transforming the approach to SE data analysis. Will computers put us out of a job? Only time will tell, but maybe we had better start saving for an early retirement.

Surface Coating, Treatment, and Analysis of Materials for Medical Devices

Bernard Li

Medtronic Neuromodulation, Minneapolis, MN

Surface coating and treatment on medical device components are critical to enhance the performance of medical devices. Surface coatings and treatments have been used in medical devices for different functions, such as insulation, low friction, wear resistance, antimicrobials, etc. All coatings and surface treatments need to undergo surface characterization in order to understand their properties. This study investigates the application of Diamond-Like Carbon (DLC) and Tungsten Carbide-Carbon (WC-C) coatings for the Sychro-Med Infusion (SMII) drug pump, as well as Titanium Oxide (TiOx) coatings for a piston pump application. Advanced surface analysis techniques, including microscopy, nanoindentation and scratch tests, were employed to evaluate coating properties, adhesion, and surface morphology. These analyses, combined with wear resistance testing, demonstrate the effectiveness of the coatings to mitigate surface degradation and to extend the functional lifespan of critical components under demanding operational conditions. The study confirms that the coatings not only improve wear resistance, but they also offer significant improvement for the durability and reliability of medical devices.

TAC Co-Chairs:

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Call for Papers

Abstract Submission Deadline
Guaranteed Session Placement: January 1, 2026

Coatings and Processes for Biomedical Applications

Coatings and surface treatments are essential to the advancement of both established and emerging biomedical technologies. Recent progress in the understanding of biological systems has accelerated the development of innovative coatings and surface engineering approaches. These technologies aim to improve osseointegration, enable neural interfaces, extend the operational lifespan of implanted devices, enhance biocompatibility, and reduce costs. These advances are not limited to implantable devices; they also support a wide range of applications such as energy harvesting for wearable health-monitoring systems, where flexibility and biocompatibility are essential.

To support continued innovation and address technical challenges in this rapidly evolving field, the Coatings and Processes for Biomedical Applications Technical Advisory Committee (TAC) welcomes paper submissions focused on coatings and surface modifications for biomedical applications. Submissions may cover material development, surface engineering techniques, characterization methods, performance evaluation, regulatory pathways, or emerging applications in the biomedical space.

Topics of interest include, but are not limited to:

- Orthopedic coatings and osseointegration,
- Cardiac rhythm management,
- Neurostimulation technologies,
- Cardiovascular interventions,
- Bio-corrosion resistance,
- Flexible and stretchable electronics,
- Biosensors, bioelectronics, and biochips,
- Antimicrobial surface treatments,
- Novel surface modification techniques (e.g., laser processing),
- High-throughput materials development,
- High-throughput and advanced characterization techniques,
- Regulatory approval strategies,
- Navigating evolving funding landscapes, and
- Market analysis and projections.

Submissions addressing other biomedically relevant topics related to coatings and surface engineering are also encouraged.

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Coatings for Energy Conversion and Related Processes

This session provides a comprehensive forum for experts and researchers to discuss the latest developments and technologies in the field of energy conversion coatings. These talks cover a wide area of applications, however with a core focus on energy conversion, storage, and management. This session brings industry, research, and academics together in order to facilitate the transfer of technology and share new and upcoming ideas and technologies for the improvement of sustainable living.

The Technical Advisory Committee (TAC) welcomes papers in the following areas:

Solar and Ambient Light Energy Conversion:

- Thin-film and thin wafer as well as perovskite silicon tandem photovoltaics for space and terrestrial applications,
- Organic flexible photovoltaics (OPV),
- Semi-transparent photovoltaics, and
- Coatings for improved performance.

Energy Harvesting:

- RF harvesting,
- Piezoelectrics, and
- Kinetic harvesting through body movement.

Energy Storage:

- Thin flexible batteries,
- Flow batteries,
- Powder surface treatment (PVD, CVD, ALD) for Li-ion batteries, Na-batteries, or solid-state batteries (or other types),
- Super capacitors,
- Coatings for improved stability, graphene and carbon nanotubes, and
- Protective coatings for the prevention of e.g., hydrogen embrittlement.

Efficient Functional Coatings:

- Radiative cooling,
- Hydrophobic and hydrophilic,
- Self-cleaning catalytic coatings,
- Development of coatings for reduction of precious metal, and
- Anticorrosive coatings.

Other Traditional Subjects:

- Smart windows,
- Selective radiators,
- Fuel cells and electrolyzers (low temperature, high temperature, advanced types), and
- Large-scale energy conversion and storage.

Yttrium Oxyhydride-Based Photochromic Coatings for Window Applications: From Lab Scale Films to Large Scale Roll-to-Roll Production

S. Zh. Karazhanov

Institute for Energy Technology, Kjeller, Norway and University of Latvia, Riga, Latvia

Yttrium oxyhydride ($YH_{3-2x}O_x$, YHO) belongs to the emerging class of mixed anion systems—materials incorporating multiple anion species, potentially enabling unique properties not found in single-anion counterparts. First discovered in 2011, YHO is synthesized via reactive magnetron sputtering to deposit $YH_{2-\delta}$, followed by oxidation in air. It exhibits photochromic behaviour under ambient conditions, transitioning from a transparent state (transmittance $T > 85\%$) to a dark state ($T \approx 20\%$) upon exposure to sunlight, with nearly uniform absorption across all wavelengths.

YHO has strong potential for various technological applications, including smart windows, protective eyewear, helmet visors, and automotive roof glass. The commercialization of roll-to-roll deposited photochromic YHO has already begun through the SME Sunphade. Today, the study of YHO and other rare-earth metal oxyhydrides is an increasingly attractive research field.

This talk will highlight key research findings on YHO, focusing on its physical and optical properties, including photochromic behavior under visible and ultraviolet light exposure, tunable transparency, and high optical stability with minimal degradation over multiple cycles. The temperature-dependent dynamics of YHO's transition between transparent and opaque states will also be discussed. Additionally, the presentation will cover ongoing studies related to durability and chemical stability, ensuring long-term reliability in practical applications, as well as efforts to enhance response times, cycling stability, and energy efficiency for large-scale implementation.

Theoretical advancements will be explored, including predictions of crystal structures for oxidized yttrium hydride, hydrogen-induced band structure modifications that explain its distinctive optical effects, and phenomena such as light-induced lattice breathing and lattice contraction/expansion. Furthermore, deposition techniques for small- and large-area glass and flexible substrates, prototype development, and functionality assessments in both laboratory and outdoor environments will be presented, along with insights from roll-to-roll deposition studies.

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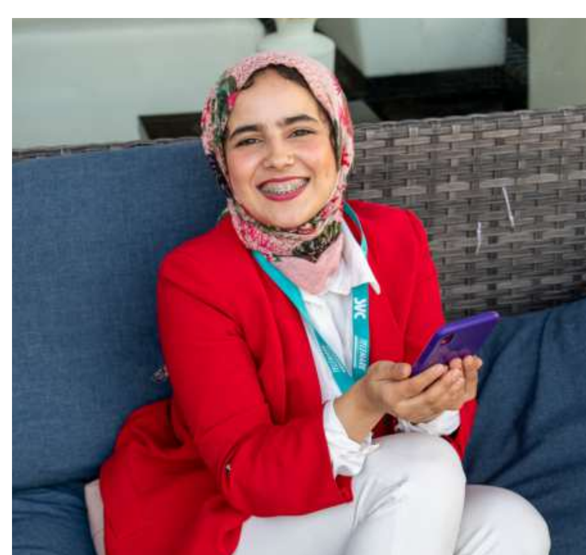
Digital Transformation through Artificial Intelligence, Machine Learning, Simulation, and Data Science in the Thin Film Industry

This session explores the transformative role of digital technologies in the domain of industrial thin film deposition, particularly within vacuum-based coating technologies. The focus is on leveraging physics-informed simulation, artificial intelligence, and data-driven methods to enhance process understanding, optimization, and control.

The session will include, but is not limited to, the following topics:

- ***Physics and Chemistry Simulations:*** Use of high-fidelity, multi-physics models to predict key process parameters like erosion and deposition profiles, film composition, ion bombardment, gas and plasma distributions, and substrate heating.
- ***Digital Twin Models:*** Real-time capable simulations that integrate equipment layout and operating parameters to forecast coating performance and variability.



- ***Machine Learning and Hybrid Approaches:*** Applications of AI for predictive maintenance, parameter tuning, and anomaly detection. Emphasis on combining limited experimental data with physical modeling for higher generalizability (greybox models).
- ***Data Infrastructure and Process Mining:*** Tools and methods for systematic data acquisition, storage, accessibility, and intelligent analysis across the coating process chain.

This session is intended for all stakeholders involved in the digital transformation: OEMs and system integrators in the vacuum coating sector, coating service providers and production engineers, developers of coater components and diagnostic tools, as well as providers of simulation software and digital services, and data mining platform providers.

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Electron Beam Processes

The Electron Beam Processes Technical Advisory Committee (TAC) is a spin-off from the International Conference on High-Powered Electron Beam Technology, originally founded by Dr. Robert Bakish in 1983. Today, high-power electron beam technology is well established for coating, melting, and welding. The EB TAC focus is the development of new coatings and coating processes using electron beam technology as well as new ebeam components, such as power supplies and beam control systems to enhance material properties. Of particular interest are improvements to equipment that enable new applications such as additive manufacturing of turbine engine components and medical implants.

The TAC supports the technical and technological exchange of knowledge to promote electron beam technology especially for industrial applications and is looking for papers on the topics listed below:

- Advances in high-rate PVD by electron beam evaporation (EB-PVD), such as for thermal barrier coatings,
- Electron beam processes for the production of novel materials,
- Additive manufacturing with electron beam,
- Thermal processes (welding, hardening, refining, drilling),
- Non-thermal processes (curing, sterilization, crosslinking, gas conversion),
- New applications for PVD by electron beam evaporation for photovoltaics, concentrated solar, energy production (fuel cells), energy storage (batteries), and high efficiency lighting,
- Modelling of electron beam sources, processes, and systems,
- New components in electron beam technology (guns, power supplies, vacuum systems, plasma assist),
- Emerging technologies (electron generation, beam guidance, etc.), and
- Related and new applications of electron beam processes.

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Emerging and Translational Technologies and Applications

This session welcomes presentations related to deposition and surface engineering technologies and applications that do not readily align with the classic session topics of the SVC TechCon program.

Modern market needs and application requirements continuously trigger innovation in the production and development of thin films and coatings. There are two trajectories that historically advance the field: (a) adjacent markets and applications expand by taking advantage of innovation in traditional technologies, and on the other side (b) established markets and applications that benefit from technical innovation in fields that previously were restricted to exterior "heritage" domains.

This session seeks to highlight new applications and markets that are enabled by advances in thin film and coating deposition, interface engineering, and surface processing. Contributed presentations may emphasize applications and markets, describe the role of enabling or cross-over technologies, as well as business topics such as market opportunity overviews, or new business and engineering concepts.

Market- and business-focused talks should generally relate to technology innovation within the SVC domain, and technology-focused talks should relate to a new market or application arena that SVC stakeholders should pay attention to.

TAC Chair:

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Call for Papers

Abstract Submission Deadline
Guaranteed Session Placement: January 1, 2026

High Power Impulse Magnetron Sputtering – HIPIMS

High power impulse magnetron sputtering (HIPIMS) has moved from lab scale to industry. Today, a significant number of industrial-scale HIPIMS processes exist as well as some commercial processes and products. Both fundamental understanding and application-oriented development are essential for exploiting the full potential of this technology.

The latest results from fundamental research, new and advanced approaches for simulation and modeling, and the combination of applied research from lab scale to industrial size cathodes and machines are the focus of this TAC. The session aims to provide a forum linking scientists, technologists, and industrialists to discuss all aspects of the HIPIMS technology.

Papers are solicited from, but not limited to, the following areas:

- Fundamental research on plasma, discharge, and coatings,
- Simulation and modeling of HIPIMS,
- New plasma sources and process modifications,
- Recent development in pulse generation and process and plasma diagnostics,
- Application oriented results: tribological, optical, medical, etc., and
- New coatings and products.

Towards Reactive-Gas-Less Sputtering of Functional Nitrides – The Role of Metal Ions in Plasma-Activated Reactive Environments

Tetsuhide Shimizu[1], Caroline Hain[2,3], Yuji Oshida[1,2], Eva Vogt[2], Thomas Nelis[2,3], Johann Michler[2]

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Nitride thin films are indispensable materials across diverse industrial sectors, including hard coatings, semiconductors, and optical devices, typically fabricated by reactive sputtering with nitrogen (N_2). Film stoichiometry and crystallinity are strongly governed by the N_2 partial pressure, but less attention has been given to the actual incorporation efficiency of nitrogen into the growing film. In particular, dissociation of N_2 molecules into atomic nitrogen within the plasma is expected to critically influence surface reaction kinetics. This study investigates the role of highly ionized metal ions of high-power impulse magnetron sputtering (HiPIMS) in the discharge with activated nitrogen species during nitride film growth, with a focus on AlN deposition by microwave (MW)-assisted reactive HiPIMS. In this approach, AlN thin films were synthesized at very low N_2 flow rates within the metallic regime, where enhanced deposition rates and improved process stability are advantageous for industrial application. To analyze discharge characteristics during the reactive mode transition, energy- and time-resolved mass spectrometry was performed using a time-of-flight mass spectrometer (E-ToFMS), enabling detailed analysis of ion dynamics under varying reactive gas conditions. The results demonstrate that highly crystallized, (0002)-oriented AlN films can be deposited at very low N_2 flow rates when MW plasma assistance is applied, whereas conventional HiPIMS under the same conditions yielded metallic Al films. Mass spectrometry revealed that even at reduced N_2 flows, high fluxes of atomic and molecular nitrogen ions were present, particularly during the pulse-off time, highlighting their decisive role in sustaining film-forming reactions. These findings clarify the mechanism of AlN growth under low N_2 pressures and emphasize the importance of dissociated nitrogen species to improve the incorporation efficiency of nitrogen duruing reactive sputtering. The insights gained not only improve process control for AlN but also provide broader implications for the synthesis of other transition metal nitrides by HiPIMS in industrially relevant conditions.

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Large Area Advanced Packaging and Integrated Photonics

The growing demand for high-performance computing, artificial intelligence, augmented/virtual reality, and advanced communication systems is driving unprecedented innovation in both large-area advanced packaging and integrated photonics. As the limits in transistor size and speed approach, the logical next steps to increase performance involve advancements in parallel computation and optimized communication between integrated components. To increase throughput, yields, thermal performance, and reduce cost, substantial focus and development effort have been put into large-area advanced packaging. As a foundational technology for these advancements, thin film deposition, a core area of expertise within the SVC community, plays a critical role in enabling the next generation of devices.

This session will explore the cutting-edge intersection of large-area manufacturing techniques for advanced packaging and integrated photonics. We encourage submissions that address challenges, present novel solutions, and showcase recent advancements in manufacturing equipment, processes, materials, and architectures.

Topics of Interest Include, but are not limited to:

Large Area Advanced Packaging:

- New process, equipment, performance, and yield requirements for advanced packaging,
- Large area packaging challenges and solutions,
- Wafer-level and panel-level packaging for integrated photonics,
- Advanced interconnects (e.g., through-silicon vias (TSVs) and through-glass vias (TGVs)), and
- Substrate technologies and interposer solutions for large-area integration.

Thin Film Deposition for Photonic Integration:

- Challenges and opportunities in scaling up integrated photonics manufacturing,

- Silicon photonics and other material platforms for integrated optics,
- Advanced dielectric and optical coatings for waveguides, filters, and resonators,
- Deposition of active photonic materials,
- The role of atomic layer deposition (ALD) and precise film control, and
- Large area physical vapor deposition (PVD) techniques for metallization and optical layers.

Manufacturing and Process Control:

- High-throughput manufacturing methods,
- Process control and in-situ monitoring for thin film deposition, and
- Yield enhancement and cost reduction strategies for large area integration.

We encourage submissions from academic and industrial researchers, engineers, and scientists working on all aspects of large area advanced packaging and integrated photonics, especially those with a focus on the underlying thin film and deposition processes. Join us to discuss the latest breakthroughs and future directions in this rapidly evolving field.

TAC Chair:

Patrick Morse, *Arizona Thin Film Research LLC,* pmorse@azthinfilm.com

Large Area Coatings

Scaling up to high volume manufacturing (HVM) has enabled tremendous cost reduction in the production of architectural and automotive glass, flat panel displays, solar cells, and roll-to-roll. Scalability comes with unique challenges. To operate a plant at HVM scales, the selected deposition method and related processes must be stable and reproducible over long operation time. Chemical and physical layer properties at the nanoscale must be precisely controlled across the meter scale. The obtained layers serve later as optical interference stacks, diffusion barriers, hard or lubricating coating for scratch resistance, transparent conductors, decorative coatings, solid electrodes or electrolytes.

The Large Area Coating Session gives you an opportunity to meet with and to learn from leading industry and academic experts in the field, present and discuss cutting edge developments in the broad field of coating applications, highlight the newest materials, methods, processes, review required equipment and software, and also discuss market trends. Session topics will cover:

- Understanding and controlling process at nanoscale with homogeneity up to meter-scale: physics and chemistry of thin films and their interfaces, analytical equipment in-/ex-situ, in-/off-line,
- Human-assisting technologies: predicting and correcting materials and processes by physical simulations and machine learning,
- 2D and 3D coatings, processes, equipment, market trends and regulations for architectural, automotive, aerospace, and display applications,
- Manufacturing methods including surface preparation, etching, sputtering (magnetron, ion beam assisted), high power impulse

sputtering (HiPIMS), evaporation, chemical vapor deposition (CVD), plasma enhanced CVD (PECVD), atomic layer deposition (ALD), plasma enhanced ALD (PEALD/PAALD), pulsed layer deposition (PLD), and

- Best practices: process engineering and transfer, quality control, upgrade of equipment, predictive maintenance, metrology, sustainability, testing and introducing new technologies, scale-up.

INVITED SPEAKER:

Mass Production of Inorganic and Organic Coatings for Display Cover Glass

Brian S. Holsclaw

Corning, Inc., Corning, NY

As automotive displays become central to modern vehicle design, it is critical for cover glass coatings to meet certain optical performance, durability, and manufacturability requirements. This presentation will discuss anti-reflective (AR) and organic coatings designed for mass production processes. AR coatings will be discussed that have specific optical attributes for automotive displays including low reflectivity, high transmission, neutral color, and minimal color shift at high-viewing angles. These AR coatings must be scalable to a large-area process and manufacturable with precision. Durability requirements must also be considered for real-world use cases for such AR coatings. From a production point of view, cost of manufacturing will depend on effective integration of an appropriate coating system within a streamlined factory flow with best-practice processing and manufacturing improvements. Such a flexible and forward-looking manufacturing strategy will allow new products and coatings to be efficiently mass produced.

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Optical Coatings

Exciting developments in optical coatings are stimulated by the latest trends in optics, optoelectronics, photonics, optical data processing, mobile devices, displays, biomedical, sensors, energy and photovoltaics, architectural, aerospace, astronomical, and other technologies. The optical coatings session will bring together these different aspects for technical interchange in the field of optical interference coatings.

To build a well-rounded optical coatings session, abstracts are solicited to cover topics including coating design, development of practical manufacturing techniques, characterization methods, and a wide range of applications.

Specific areas may include:

- Novel optical coating materials, including metamaterials and metasurfaces,
- New fabrication processes for optical coatings,
- Novel optical interference design software and design techniques,
- Production issues common to the industry – including lessons learned or serendipitous discoveries that came from problems or disasters,
- Metrology of optical films (new instrumentation and software developments, inline or in-situ approaches, etc.),
- Real-time process monitoring and control with optical coating processes,
- Industrial scale-up,
- Preconditioning and cleaning issues; refurbishment approaches for optical coatings,
- Coatings on sapphire, polymers or other special substrate materials, coatings for complex 3-D optical devices,
- Applications in non-traditional wavelengths, from EUV to IR (e.g., IR thermal imaging),
- Optical coatings for mobile electronics (e.g., fingerprint sensors, cameras, displays, touchscreens, etc.),
- Optical coatings for wearable technology, including AR/VR,
- Coatings for LIDAR/driverless vehicles,
- Optical coatings for biomedical applications,
- Optical coatings for energy control and solar power,
- Optical coatings for laser applications, including femto-second lasers,
- Optical coatings for display and integrated photonic device applications,

- Optical coatings for astronomy and aerospace, and
- Optical coatings for quantum optics.

INVITED SPEAKERS:

State of the Art of Amorphous IBS Coatings Improvements for the Gravitational Wave Detectors and Other Applications

L. Pinard, C. Michel, B. Sassolas, J. DeGallaix, D. Forest, M. Granata, L. Mereni, J. Teillon
Laboratoire des Matériaux Avancés – CNRS, Villeurbanne, France

For the first time in September 2015, a direct detection of gravitational wave occurred in the LIGO interferometers. These advanced detectors need large fused silica mirrors (34-35 cm diameter, 20 cm thick) having optical and mechanical properties never reached up to now. LMA has developed and optimized these IBS (Ion Beam Sputtering) coatings on the mirrors of the Fabry-Perot arm cavities of the LIGO or Virgo gravitational wave detectors to get:

- the lowest optical losses (0.3 ppm absorption at 1064 nm, around 5 ppm of scattering)
- the lowest mechanical losses (thermal noise reduced by the use of Ti:Ta_2O_5 as high index layer)
- the best coating uniformity (<0.1 % on 150 mm diameter).

To improve the detector sensitivity, the laser power has increased during the following scientific runs and a problem appeared in the high reflective coating: some very high absorbing points (several hundreds of ppm) can be present. Some investigations were done to understand and find their origin, and a solution was found to suppress them. This optimization was helpful for other projects using high finesse cavities.

The other noise limiting the detector performances in the 100 Hz region is the coating thermal noise, coming from the high index layer. Some R&Ds started at LMA (Working Group between LIGO and Virgo) to find a new material able to reduce this noise by a factor of 2. The best candidate is the Ti:GeO_2. Some final results will be presented.

Recent Innovations in Optical Coating Design Software

Michael Trubetskov[1,2]
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Modern software packages in the field of multilayer optical coatings cover many classes of different problems, including analysis and synthesis of multilayers, characterization of monolayers, reverse-engineering of produced multilayer coatings, real-time control of deposition processes using broadband or quasi-monochromatic optical monitoring, and computer simulation of multilayer production. This wide coverage of various classes of problems is essential to achieve high-quality multilayer coatings, addressing new challenges in science and technology.

Various aspects of innovative software support are considered, including efficient ways to solve direct problems of multilayer coating evaluation involving vectorization and parallelization of computations. Efficient methods of solving synthesis problems are discussed, including classic and deep search needle synthesis, gradual evolution, and multi-start optimization. The choice and correct specification of targets—ranging from spectral and integral values, absorptance, and electric field to stress and thickness—are critical. For ultrafast optics, specialized targets include group delay (GD) and group delay dispersion (GDD), and multi-coating configurations for dispersive mirror compressors are involved.

Recent innovations integrate deep search methods able to provide solutions with excellent performance on the one hand and production-friendly tools, such as design cleaner, bound-trap, thick layer reduction, and robust synthesis.

Characterization determines optical parameters of substrates and layer materials, while reverse engineering identifies and compensates for repeatable production errors. Special adaptations support large area manufacturing in automotive, architectural, and wafer applications. Real-time characterization and re-optimization mitigate non-repeatable deposition errors.

Insights from recent Optical Interference Coatings (OIC) design challenges underscore the progress and creativity in tackling these complex problems, illustrating the interplay between theory, computation, and manufacturing realities in modern multilayer optical coating technology.

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Organic and Perovskite Electronics

Organic and organometal-halide perovskite materials have emerged in recent years as important alternatives to traditional inorganic materials for optoelectronic devices. These novel materials provide huge potential benefits such as reduced-cost processing, compatibility with nonconforming and flexible substrates, and tunable color properties, allowing for a range of interesting applications. Organic light-emitting diodes (OLEDs) have become widespread commercially in displays, with improvements in brightness and contrast ratios, as well as interesting form factors such as thin and flexible devices. Perovskite-based photovoltaic devices are attracting considerable interest as a potentially disruptive energy technology, with power conversion efficiencies similar to or in excess of those seen in current panels but with simpler processing requirements.

Like any interesting and fast-growing field of technology, the achievements and benefits in the field of organic/organometallic electronics and optoelectronics don't come without their own challenges. The inherent properties of these materials make them challenging to deposit using a vapor-phase technology:

- The materials are typically prone to decomposition at relatively lower temperatures which has led to development and use of evaporation sources with a complex set of features and temperature control mechanisms.
- Additionally, some of the active films in the device architecture require precise rate control algorithms to achieve the required host-dopant compositions, which in turn also require critical hardware considerations.
- Materials are mostly sensitive to moisture and oxygen, so the protection from these elements during and post-fabrication is critical.

These factors require a deep understanding of material properties, study and treatment of substrates and interfacial properties of layers, considerations of the bottlenecks towards device fabrication, encapsulation techniques and thin-film deposition system solutions, and combined they result in an exciting process in this field of study.

This session welcomes papers addressing materials and processing challenges related to these technologies involving vacuum and vapor-based techniques such as evaporation, sputtering and ALD. We encourage submissions on practical approach towards fabrication of organic devices and emphasizing key parameters to consider during the design and building steps. Discussion on challenges and opportunities in scaling up processes for industrial production will be integral to the session.

The session will include discussions on research on the following device types:

- Organic and perovskite light-emitting diodes (OLEDs and PLEDs),
- Organic and perovskite photovoltaics (OPV and perovskite PV),
- Hybrid inorganic/perovskite tandem photovoltaics,
- Organic thin film transistors (OTFTs and OFETs),
- Organic memory devices and spintronics,
- Organic sensors,
- Flexible and wearable electronics, and
- Building-integrated photovoltaics (BIPV).

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Photonically-Induced Transformations of Thin Films and Surfaces

Lasers, flash lamps, and other highly energetic illumination sources enable rapid thermal processing of surfaces and thin films for scaled, low-cost materials and technologies in areas of high economic, societal and environmental impact. Realization of surface-selective rapid thermal annealing coupled with high-throughput are especially attractive features of photonic materials engineering.

This session provides a forum to discuss pioneering technological applications bound by the common thread of photonically-based methods for surface and thin film annealing, materials synthesis and surface patterning.

We welcome submissions addressing the following key areas:

- Surface selective annealing of bulk materials and thin films with light typically in the <100 ms range,
- Wafer based and large area in-line applications,
- Laser and flash-lamp-based conversion and synthesis of high quality, crystalline materials (transparent and conductive layers, energy harvesting, sensor material, low-power computing, multifunctional 'More than Moore' electronic device technology, large area photocatalysts and smart materials for window applications),
- Rapid patterning of microelectronic devices without photolithography (sensors, medical implants, and hardware for experiments and IoT devices),
- Control of nano-micro scale surface morphology (cell adhesion, directed fluid flow),
- Photonically-induced chemical activation of surfaces for antipathogenic, anti-smudge, (de)wetting properties, and
- Novel photonic illumination processes and devices.

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Call for Papers

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Guaranteed Session Placement: January 1, 2026

Plasma Processing and Diagnostics

This session welcomes contributions focused on the development, understanding, and application of plasma-based techniques for thin film coatings and surface modification. The scope includes both established and emerging approaches for plasma-enhanced deposition and treatment, emphasizing the underlying physical and chemical processes, diagnostics, and modeling strategies that enable performance optimization and scalability in industrial environments.

Topics of interest include:

- Physical vapor deposition (PVD) including magnetron sputter-deposition in conventional and non-conventional arrangements,
- Plasma-enhanced chemical vapor deposition (PECVD) both on process and application side,
- Plasma-based etching in the semiconductor industry and other applications,
- Development of novel plasma sources for materials processing (e.g., mid-pressure, atmospheric pressure, nanosecond-pulsing, micro plasmas, etc.),
- Hybrid systems and hybrid processes integrating different plasma technologies,
- Atmospheric-pressure plasma processing, including dielectric-barrier discharges and plasma jets,
- Plasma diagnostics for understanding plasma dynamics and plasma-material interaction,
- Modelling and simulation of plasma and plasma-surface interactions, and
- Novel plasma processing methods such as treatment of nanoparticles, nanomaterials, and liquids, as well as plasma catalysis.

This session is particularly relevant for industry practitioners, researchers, and scientists:

- Working on the design, scale-up, and implementation of advanced plasma sources and coating technologies,
- Developing novel plasma-based processes or deposition techniques, and
- Engaged in the experimental diagnostics of laboratory or industrial plasma systems.

By fostering a technical exchange among these communities, the session aims to advance both the fundamental science and practical applications of plasma processing in thin film technologies.

TAC Co-Chairs:

Hana Baránková, *Uppsala University,* hana.barankova@angstrom.uu.se
Kristína Tomanková, *PlsmaSolve s.r.o.,* tomankova@plasmasolve.com
Oleg Zabeida, *Polytechnique Montréal*, oleg.zabeida@polymtl.ca

Assistant TAC Chairs:

Lenka Zajíčková, *Central European Institute of Technology & Masaryk University,* lenkaz@physics.muni.cz
Craig Outten, coutten@verizon.net

Process Monitoring, Control, and Automation

As the fourth industrial revolution transforms manufacturing, the demand for intelligent, automated vacuum processing systems is rapidly growing. This session explores the forefront of automation technologies reshaping thin film deposition, plasma processing, and surface engineering.

Achieving high repeatability, reproducibility, and yield levels requires robust solutions for real-time process monitoring and control. While the benefits - such as increased throughput, reduced material and energy waste, and lower operational costs - are well recognized, the path to reliable automation remains complex. Challenges include sensor and actuator integration in harsh environments, data fusion across different systems, the development of adaptive, autonomous control algorithms and cybersecurity.

This session focuses on practical solutions while highlighting the latest advances in:

- Embedded real-time sensors and actuators,
- Cyber-physical monitoring and control systems,
- Digital twins for process control,
- Automation and digitalization,
- AI and machine learning for predictive and adaptive automation,
- Robotic systems for material handling and process execution, and
- Autonomous materials discovery and optimization platforms.

We welcome contributions from researchers, engineers, and solution providers that address these challenges through innovative technologies, case studies, or system-level implementations. Presentations that demonstrate practical applications, integration strategies, or lessons learned from deployment are especially encouraged.

Join us to explore how automation and digitalization enable the next generation of intelligent vacuum processing systems.

Call for Papers

Abstract Submission Deadline
Guaranteed Session Placement: January 1, 2026

Beyond Ion Gauges: Wide-Range, Maintenance-Free Vacuum Sensing for Modern Coating Systems

Caspar Ask Christiansen, Ole Wenzel
Sens4 A/S, Hellebaek, Denmark

Precise and reliable vacuum measurement is essential to achieving consistent, high-quality results in modern vacuum coating processes. Traditionally, this has required a combination of sensors—including ionization gauges—to cover the full vacuum range. However, recent advancements in sensor design and materials now make it possible to significantly extend the functional range and durability of thermal and mechanical gauges, challenging long-standing dependencies on fragile, high-maintenance technologies.

This talk presents recent breakthroughs in vacuum gauging that enable wide-range, gas-independent measurement without the need for ionization gauges. Central to this development is the integration of MEMS-based Pirani sensors with high-resolution piezo resistive diaphragm sensors and capacitance diaphragm gauge sensors, enabling seamless pressure coverage across six decades. The inclusion of automatic zero-offset adjustment of the diaphragm type sensors further reduces drift and eliminates the need for frequent manual zero adjustment, offering huge savings.

To address the challenges of harsh process environments, advanced protective strategies have been implemented. Conformal coatings—such as high-purity Al_2O_3 applied by atomic layer deposition (ALD)—provide exceptional resistance to corrosive gases, while preserving sensor sensitivity and response time. Novel replaceable baffle designs, further increase the resilience towards sensor contamination. These innovations dramatically extend sensor lifespan and reduce maintenance intervals, lowering total cost of ownership.

Finally, the talk will explore the role of modern digital interfaces, including EtherCAT, in enabling faster, more reliable integration of vacuum gauges into coating system control architectures. Together, these advancements represent a new generation of vacuum sensing solutions—robust, low-maintenance, and fully aligned with the demands of high-throughput, precision coating operations.

Transforming Process Innovation through Advanced Chamber Pressure Control

Pedro Reyero Santiago, Preston Ernst, Dominic Mayrhofer
VAT Vakuumventile AG, Haag, Switzerland

New processes and applications in the vacuum industry, especially in semiconductor manufacturing, require faster and more precise control of the conditions in the vacuum chamber. VAT has developed a new pressure control solution to optimize performance on each process individually by leveraging auto-learning and feed-forward control strategies. This is achieved by training VAT's pressure control algorithms specifically on the actual process of interest, instead of using a universal control strategy. Through this new approach, it is possible to achieve better raw pressure control performance, resulting in higher process efficiency, as well as on-wafer performance improvements. Furthermore, it opens the door to new process innovation in vacuum manufacturing by enabling new process control strategies that are challenging to achieve with state-of-the-art pressure control technology, such as stable control of highly dynamic pressure changes or maintaining a stable chamber pressure during fast gas pulses in Atomic Layer processing. Coupling these new control strategies with high-end control devices (sensors, drives, gas inlet systems, …) allows to push the performance to the system's physical limits for each particular process. Lastly, VAT is targeting higher run-to-run process repeatability and improved chamber-to-chamber matching with this new pressure control solution.

TAC Chair:
Martynas Audronis, *Nova Fabrica Ltd.*, martynas@novafabrica.biz
TAC Co-Chairs:
Gun Hwan Lee, *Korea Institute of Materials Science,* ghlee@kims.re.kr
Edmund Schuengel, *VAT Vakuumventile AG,* E.Schuengel@vat.ch

Protective, Tribological, and Decorative Coatings

The Protective, Tribological and Decorative Coatings Technical Advisory Committee (TAC) encourages speakers to submit presentations dealing with design, research, development, applications, and production of coatings deposited with vacuum processes, the characterization of their properties related to wear, friction, and corrosion, and to assess their protection of the receiving components, such as cutting and forming tools, engine components, as well as decorative parts.

Call for Papers

Abstract Submission Deadline
Guaranteed Session Placement: January 1, 2026

The use of such coatings is typically driven by performance requirements, reduction of life-cycle cost, environmental consideration, and durable cosmetic and aesthetic designs. These end-user motivations lead to dedicated coating and technology developments, vacuum coating equipment concepts, new testing procedures and methods, and production quality standards. Therefore, successful coating solutions in the marketplace require strong co-operation between market specialists, universities, suppliers, manufacturers, and end-users.

The TAC encourages speakers to present on the subjects of new emerging technologies. Developing and scaling up from laboratory to high volume production at high production yields is also of high interest of the participants in this session.

Today's global landscape is changing rapidly and will drive many new application developments that will include new coatings on new applications. Environmental pressure on CO_2 emissions and electroplating as well as fast moving communication technologies are well known examples of such change. Electrification of transportation and moving away from the combustion engine are daily news.

Topics of interest for this session include, but are not limited to:

Applications:

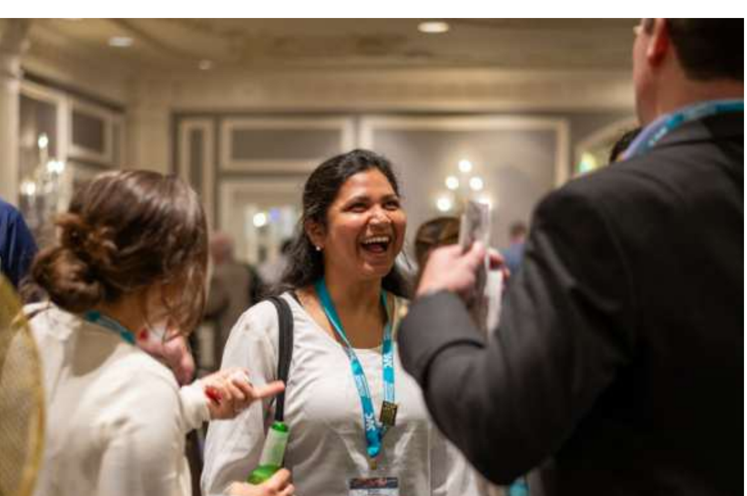
- Hydrogen economy related components,
- Coatings for high-performance engines, including hydrogen and e-fuels combustion,
- PVD and CVD coatings for cutting, forming and molding tools,
- Coatings for the reduction of friction and exhaust gas emissions,
- Low- and high-temperature coatings for aerospace applications,
- Decorative components and large area prefabricated sheets,
- Corrosion protective coatings (e.g. Zn:Al) on large-area surfaces, and
- Electroplating replacements by vacuum deposited coatings.

Development:

- Super-lubricity coatings,
- Corrosion protection,
- New colors,
- Hydrogen embrittlement barriers,
- Testing and evaluation of coating performance,
- Scale-up of vacuum coating processes for industrial demands,
- Failure analysis of coatings,
- Assessment, control and management of residual mechanical stress,
- Duplex coatings and thin-on-thick systems, and
- Modelling approaches to performance analysis and prediction.

Production Related:

- Reliability and life of coated parts and systems,
- Upscaling from laboratory to production,
- Scrap rates from percentages to ppm levels, and
- Integration of Industry 4.0 in vacuum coating plants.



INVITED SPEAKER:

PVD Coatings for Tribological Applications – Known Paths and New Perspectives

K. Bobzin, C. Kalscheuer

RWTH Aachen University, Aachen, Germany

Physical Vapor Deposition (PVD) technology and coatings are integral part of today's products and production routes. Efficient process development, coatings tailored to specific applications, and performance prediction of coated components are crucial topics. Regarding process and coating development, experimental and iterative approaches are still common. However, synergies between experiment and simulative capabilities gain increasing importance. Regarding performance prediction of coated components, the interplay between experiment and simulation becomes even more important.

Within this presentation, tribological nitride, oxide and oxynitride coatings as well as self-lubricating coatings for tools and components are addressed. The deposition technologies span from magnetron sputtering over arc-PVD to gas flow sputtering. The field of applications reaches from cutting and forming tools until machine elements such as gears and chains.

Prediction of coating properties and coating performance in applications cannot be solved solely by physics-based approaches up to now. Within this context, approaches to determine coating properties from process parameters by data-driven methods are shown. Regarding performance prediction, greybox models that combine physics-based models and data-driven methods are very promising. Current research on greybox models for wear prediction of cutting tools is presented.

TAC Co-Chairs:

Martin Engels, *Ionbond,* martin.engels@ionbond.com
Anas Ghailane, *Avaluxe Coating Technologies,* AGhailane@avaluxe-technologies.de
Jolanta Klemberg-Sapieha, *Polytechnique Montréal,* jsapieha@polymtl.ca
Christoph Schiffers, *CemeCon,* christoph.schiffers@cemecon.de
Christian Stein, *Fraunhofer IST,* christian.stein@ist.fraunhofer.de

Call for Papers

Abstract Submission Deadline
Guaranteed Session Placement: January 1, 2026

Quantum Computing

Quantum computing promises to harness the power of quantum mechanics to solve problems unfathomable for classical computers to resolve. Quantum computing, once a theoretical dream, is now experiencing an unprecedented surge of progress. Driven by intense research efforts, substantial investments, and collaboration across academia and industry, quantum computing technology is rapidly approaching reality with a promise to revolutionize fields ranging from materials science and drug discovery to finance and artificial intelligence. The quantum computing session aims to explore the current state and prospects of this transformative technology.

The session welcomes researchers, academics, and industry leaders to explore the cutting edge of quantum computing and share their insights on its remarkable emergence. We seek submissions on a range of topics, including:

Quantum Hardware and Software:
- Progress and challenges in superconducting qubits, trapped ion, topological, and other platforms,
- Novel device architectures and fabrication techniques,
- Algorithmic breakthroughs, development frameworks, and their practical applications,
- Error correction and fault-tolerance techniques, and
- Benchmarking and performance analysis.

Scalability Challenges:
- Bridging the gap between quantum and classical systems, and
- Architectures for large-scale quantum computing.

Applications:
- Emerging applications in materials science, drug discovery, and encryption,
- Quantum-enhanced machine learning and artificial intelligence, and
- Financial modeling and risk analysis.

Impact:
- The ethical implications and impact of quantum computing on society,
- Educational initiatives and talent development for the quantum workforce, and
- Commercialization and industry trends in quantum technology.

TAC Co-Chairs:

Mike Miller, *Angstrom Engineering,* mmiller@angstromengineering.com
John Naylor, *Kurt J. Lesker Company,* johnn@lesker.com
Akhil Vohra, *Angstrom Engineering,* avohra@angstromengineering.com

Thin Film Contributions for the Hydrogen Economy

This session is focused on the role of physical vapor deposition (PVD) and related thin film and surface engineering technologies in the emerging hydrogen economy. This session aims to bring together experts, researchers, and industry professionals from around the world to share their knowledge and insights on the application of PVD thin film coating techniques in advancing the use of hydrogen as a clean energy source.

Participants will have the opportunity to present their research findings, case studies, and innovative approaches in utilizing PVD thin film coating technology for various aspects of the hydrogen economy. The topics of interest include but are not limited to: PVD coatings for hydrogen storage materials, PVD methods for fuel cell catalyst preparation, thin film coating-based hydrogen production and purification techniques, and advancements in thin film coating processes for the manufacturing of hydrogen-related devices and components. Specific industrial implementation of solutions is of critical importance to the SVC's international stakeholder base.

The SVC TechCon provides a unique platform for scientists, engineers, and industry leaders to collaborate, exchange ideas, and explore the potential of thin film coating technology in shaping the future of the hydrogen economy. We encourage interested individuals and organizations to submit their abstracts showcasing their contributions to this rapidly evolving field. Together, let us uncover the transformative capabilities of thin film coating technology and pave the way for a sustainable and efficient hydrogen-powered future.

TAC Co-Chairs:

Ralf Bandorf, *Fraunhofer IST,* ralf.bandorf@ist.fraunhofer.de
Herbert Gabriel, *PVT Plasma und Vakuum Technik GmbH,* h.gabriel@pvtvacuum.de
Lucia Mendizabal, *Tekniker,* lucia.mendizabal@tekniker.es

WebTech Roll-to-Roll Technologies and Innovation

WebTech is the forum for flexible web and roll-to-roll (R2R) processing at the SVC. It is the podium to present new achievements in processing of flexible substrates such as polymer, textile or glass. The session scope encompasses materials, manufacturing techniques,

products, applications, market developments and economical aspects of this versatile high-volume manufacturing method.

The WebTech TechCon session typically features presentations on materials, deposition processes, manufacturing techniques (including "best practices"), use cases / application examples, market analysis and business perspectives in all areas related to R2R processing.

Some pertinent topic focus areas are:

- Substrate materials and technologies (polymer, flexible glass, fabrics and non-wovens, etc.),
- Deposition sources and deposition modalities specific to R2R processing,
- Inline process diagnostics and control (particularly for non-transparent coatings),
- Modeling and simulation of R2R processes,
- Examples and approaches to utilize artificial intelligence (AI), machine learning, and other "Industry 4.0" modalities in R2R,
- Aspects of progressing R2R coatings from concept demonstration to commercial scale,
- Coatings under harsh conditions,
- Interfacing with non-vacuum/atmospheric pre- and post-processing, including cleaning,
- Low-cost/high-performance barrier coatings, and,
- R2R processing for electronics, semiconductor and energy conversion applications.

TAC Chair:
Chris Stoessel, *Stoessel Consulting,* cstoessel@stoesselconsulting.net

Assistant TAC Chairs:
Hazel Assender, *University of Oxford (Begbroke),* hazel.assender@materials.ox.ac.uk
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Robert Malay, *Intellivation,* rmalay@intellivation.com
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Joe Papalia, *Deposition Technology Innovations,* jpapalia@dtifilms.com
Jerry Wu, *Enpack Composite,* wufujw@163.com

Technical Poster Session

Poster Presentations serve as an important component of the Technical Porgram by providing a format for extended discussions of the results in a casual environment.

The Program Committee encourages poster presentations on all topics covered in the Call for Papers. A $200 USD cash award for the Best Poster will be offered. This year the SVC Young Members Committee will be offering an additional $200 USD prize for the best Student/Young Member poster presented at the session. **Submit an abstract for your presentation in the Poster Session before February 14, 2026.**

Conference Calendar

Start planning now for your trip to TechCon 2026

SUNDAY April 26	MONDAY April 27	TUESDAY April 28	WEDNESDAY April 29	THURSDAY April 30

Education Program

30+ Tutorial Courses

TechCon Registration Counter Hours:

Sunday, April 26	7:00 a.m. – 10:00 a.m. and 4:00 p.m. – 7:00 p.m.
Monday, April 27	7:00 a.m. – 6:00 p.m.
Tuesday, April 28	7:00 a.m. – 5:30 p.m.
Wednesday, April 29	7:00 a.m. – 5:00 p.m.
Thursday, April 30	7:00 a.m. – 12:00 p.m.

Technical Program

Exhibit

Exhibit Open Hours

11 a.m. – 6 p.m. Tuesday
10 a.m. – 4 p.m. Wednesday

Conference Registration Open

Long Beach Convention Center

CONFERENCE REGISTRATION FEES*

Back AGAIN for 2026!

All paid conference registrations will include one free SVC in-person tutorial at the TechCon and a 30% discount on additional courses.

Attendee Registration (through March 1, 2026/after March 1, 2026)

- ❏ Full Conference .... $995.00/$1095.00
- ❏ Media Personnel $0.00
- ❏ Student Conference .... $400.00/$500.00
- ❏ Young Members Group Conference.......... $400.00/$500.00
- ❏ Exhibit Visitor Only .... FREE

Exhibitor Registration (through March 1, 2026/after March 1, 2026)

- ❏ Exhibitor Booth Personnel and Manufacturer's Representative $0.00
- ❏ Exhibitor with Full Conference Registration .... $995.00/$1095.00

Special Events at the TechCon

- ❏ SVC Foundation Virtual 5K Run $40.00
- ❏ Awards Ceremony and Welcome Reception (Tuesday Evening) .... No Fee
- ❏ SVC Foundation Casino Night Fundraiser (Monday Evening).......... 1 Ticket Included with Full Conference Registration (additional tickets $75.00)
- ❏ Farewell Social (Thursday Evening).......... No Fee

** Pricing contingent on making hotel accommodations at the Hyatt Regency Long Beach/Hyatt Centric Long Beach*

TechCon 2026 Long Beach

Technical Program April 27 – April 30
Education Program April 25 – April 30
Technology Exhibit April 28 – April 29

69th Annual SVC Technical Conference • April 25 – 30, 2026
Long Beach Convention Center, Long Beach, California, USA

Processing Cluster

- C-103 An Introduction to Physical Vapor Deposition (PVD) Processes
- C-201 Electron Beam Evaporation for Thin Film Deposition
- C-204 Basics of Vacuum Web Coating
- C-207 Evaporation as a Deposition Process
- C-208 Sputter Deposition for Industrial Applications
- C-210 Introduction to Plasma Processing Technology
- C-212 Troubleshooting for Thin Film Deposition Processes
- C-214 Thin Film Deposition Optimization
- C-240 Fundamentals of Ion Beam Sputtering
- C-245 Industrial Broad Beam Ion Sources
- C-250 Introduction to Pulsed Laser Deposition
- C-280 Thermal Spray Technology
- C-304 ITO and Other Transparent Conductive Coatings: Fundamentals, Deposition, Properties, and Applications
- C-306 Non-Conventional Plasma Sources and Methods in Processing Technology
- C-307 Cathodic Arc Plasma Deposition
- C-308 Tribological Coatings
- C-310 Sputtering
- C-314 Plasma Modification of Polymer Materials and Plasma Web Treatment
- C-316 Introduction to Atomic Layer Deposition (ALD) Processes, Chemistries, and Applications
- C-323 Fundamentals of High Power Impulse Magnetron Sputtering (HIPIMS)
- C-324 Atmospheric Plasma Technologies (half day)
- C-332 Zinc Oxide-Based and Other TCO Alternatives to ITO: Materials, Deposition, Properties and Applications
- C-334 Manufacture of Precision Evaporative Coatings
- C-336 Transparent Gas Permeation Barriers on Flexible Substrates
- C-337 ITO and Alternative TCO: From Fundamentals to Controlling Properties
- C-343 From Basic Aspects to Industrial Components and Applications in HIPIMS Technology
- C-333 Practice and Applications of High Power Impulse Magnetron Sputtering
- C-338 Application of Reactive Sputtering
- M-120 Design of Experiments for R&D
- M-150 Cleaning Fundamentals for Coating Applications
- M-240 Basics and Applications of Electron Beam Technology for Manufacturing Processes
- VT-230 Design and Specification of Vacuum Deposition Systems

Optical Cluster

- C-205 Introduction to Optical Coating Design
- C-216 Practical Design of Optical Thin Films
  - C-218 Advanced Design of Optical Thin Films
- C-217 Practical Production of Optical Thin Films
- C-340 Plastic Optics - Coatings and Antireflective Structures
- C-341 Processing on Flexible Glass - Challenges and Opportunities
- M-205 The Craftsmanship of Ophthalmic Coatings

Vacuum Technology Cluster

- M-140 Mass Flow Controllers: Fundamentals, Troubleshooting, and Calibration
- VT-201 High Vacuum Systems and Operations
- V-202 Vacuum System Gas Analysis
- VT-203 Residual Gas Analyzers and Analysis
- V-204 Vacuum Systems Materials and Operations
- V-207 Operation and Maintenance of Production Vacuum Systems
- V-208 Basic Ananlysis of Mass Spectrometer Spectra
- V-209 Fundamentals of Vacuum Technology and Vacuum Gauging
- V-210 Pumps Used in Vacuum Technology
- V-211 Vacuum Hardware and Vacuum Leak Detection
- V-212 Vacuum System Design
- VT-220 Practical Guide to Vacuum System Operation Using a Trainer System
- VT-230 Design and Specification of Vacuum Deposition Systems
- VT-240 Practical Elements of Leak Detection
- VT-245 Hands-on Helium Mass Spectrometer Leak Detection

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Course Catalog (September 2025)

Characterization Cluster

- M-102 Introduction to Ellipsometry
- M-103 In Situ Spectrascopic Ellipsometry
- M-110 Introduction to X-ray Photoelectron Spectroscopy
- M-130 Scanning Electron Microscopy Sample Preparation, Image Optimization, and Microanalysis
- M-230 Nanoscale Heat Transfer in Thin Films and Interfaces
- M-250 Deposition Process Simulation
- C-322 Characterization of Thick Films, Thin Films, and Surfaces

PVD Cluster

- C-103 An Introduction to Physical Vapor Deposition (PVD) Processes
- C-201 Electron Beam Evaporation for Thin Film Deposition
- C-207 Evaporation as a Deposition Process
- C-208 Sputter Deposition for Industrial Applications
- C-212 Troubleshooting for Thin Film Deposition Processes
- C-214 Thin Film Deposition Optimization
- C-240 Fundamentals of Ion Beam Sputtering
- C-250 Introduction to Pulsed Laser Deposition
- C-307 Cathodic Arc Plasma Deposition
- C-310 Sputtering
- C-323 Fundamentals of High Power Impulse Magnetron Sputtering (HIPIMS)
- C-333 Practice and Applications of High Power Impulse Magnetron Sputtering
- C-334 Manufacture of Precision Evaporative Coatings
- C-338 Application of Reactive Sputtering
- C-343 From Basic Aspects to Industrial Components and Applications in HIPIMS Technology
- M-240 Basics and Applications of Electron Beam Technology for Manufacturing Processes
- M-250 Deposition Process Simulation

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gram

Application Cluster

- C-220 Introduction to Two-Dimensional Materials
- C-230 PVD Processing of Plastics for Better Protection, Reflection, and Decoration (half day)
- C-260 Organic Electronics - The Future is Bright
- C-270 Coatings, Thin Films and Surface Solutions for Biomedical Applications: An overview of market trends, synthesis and characterization
- C-304 ITO and Other Transparent Conductive Coatings: Fundamentals, Deposition, Properties, and Applications
- C-320 Diamond Like Carbon Coatings-From Basics to Industrial Realization
- C-329 Properties and Applications of Tribological and Decorative Coatings
- C-330 Introduction to Thin Film Photovoltaic Technologies (half day)
- C-332 Zinc Oxide-Based and Other TCO Alternatives to ITO: Materials, Deposition, Properties and Applications
- C-336 Transparent Gas Permeation Barriers on Flexible Substrates
- C-337 ITO and Alternative TCO: From Fundamentals to Controlling Properties
- C-339 Mechanical Heart Valve Thrombosis: An Introduction and Review (half day)
- C-340 Plastic Optics - Coatings and Antireflective Structures
- C-341 Processing on Flexible Glass - Challenges and Opportunities
- C-342 Thin Film Photovoltaic Solar Cells
- M-140 Mass Flow Controllers: Fundamentals, Troubleshooting, and Calibration
- M-201 Flexible Electronics
- M-205 The Craftsmanship of Ophthalmic Coatings
- M-210 Introduction to Solid-State Thin Film Batteries
- M-220 Thin Film Superconductor Tapes
- M-240 Basics and Applications of Electron Beam Technology for Manufacturing Processes
- M-250 Deposition Process Simulation

Business Cluster

- B-101 Creating a Business from your Idea, Product or Service
- B-110 Getting the Most Value out of Marketing without Spinning your Wheels
- B-120 Introduction to Patents and Trademarks
- B-130 Doing Business in the U.S.A.

Networking Opportunities at the 2026 TechCon

Make Connections

The TechCon is packed with networking events designed to connect vacuum coating and surface engineering professionals with the global SVC community. Each technical and social networking event provides a different forum for invaluable face-to-face interactions and the opportunity to collaborate with technical experts.

Technology Forum Breakfasts

Vacuum coating technology spans multiple applications and processes. Join a discussion group focused on a topic that's important to you. Enjoy the conversation over breakfast before the start of the technical program Monday, Tuesday and Thursday. Late afternoon sessions are currently under development for Monday and Thursday.

Exhibit Networking

Enjoy more opportunities than ever to visit the Exhibit Hall.

- Welcome Lunch and Cocktail Hour are two separate events held in the exhibit hall during the first day of the technical exhibition.
- Poster Session
- Beer Blast

Additional Networking:

- Technical Program Keynote Presentations
- Exhibitor Innovator Showcase
- Colloquium Round Table Discussions

SVC Foundation Networking Events

CASINO NIGHT

Come and join us for an evening of fun and networking, all to help a great cause at the Annual SVC Foundation Casino Night on Monday, April 27, 2026.

To all of our SVC Stakeholders:

The **Technology Forum Breakfasts** have emerged as one of the most significant networking events at the TechCon. These breakfasts, held from 7:00 a.m. to 8:30 a.m. during the TechCon are "loosely" organized around a specific topic where we provide a moderator, a continental breakfast, plenty of seating, and an opportunity for free form discussion to take place. In the TFBs problems are solved, new ideas are vetted, relationships are made and rekindled; all in the spirit of camaraderie that has made the SVC the most unique technical conference in our field. This year we are expanding the program even further with early evening Sunset sessions under development for Monday, April 27 and Thursday, April 30. Please be sure to check the daily schedule (the TFBs are offered on Monday, Tuesday, and Thursday of the TechCon) to find those topics that interest you! And remember, we are always looking for new topics as well as moderators to get the discussion going in the mornings. Good luck and have fun!

– Frank Zimone, Executive Director

RUN FOR A CAUSE!

Register for the Annual 5K Fun Run and support the scholarship efforts of the SVC Foundation. Bib pickup is tentatively scheduled for 5:30 a.m. on Wednesday, April 29, 2026, outside the Convention Center entrance.

Back by Popular Demand: FREE Technical Conference Admission for April 28th & 29th

Networking Opportunities at the 2026 TechCon

2026 SVC TechCon Farewell Social

Date: **Thursday, April 30, 2026**

Everyone is invited to attend

The **Farewell Social** will be the last networking event of the TechCon and will commemorate what promises to be the most successful TechCon yet! Come join us as we celebrate our Young Members and all the new connections that were made after a densely packed four day program.

2026 SVC Awards Ceremony and Welcome Reception

Date: **Tuesday, April 28, 2026**

Everyone is invited to attend

The **Awards Ceremony** will introduce and recognize the Nathaniel Sugerman Memorial Award recipient, SVC Fellow-Mentor Award recipients, and Sponsored Student awardees.

The **Welcome Reception** is a popular networking event at the TechCon. It offers a relaxed venue to meet friends and colleagues and provides the opportunity to make new connections. In 2026 the Welcome Reception will be broken into a lunch at 1:00 p.m. and a cocktail hour at 5:00 p.m; all held in the exhibit hall.

Job Board

There will be a Job Board in the exhibit hall adjacent to the poster session. Open positions as well as resumes of those looking for a position can be posted. Messages for interested parties, either potential employer or employee, can also be posted on the board.

Back by Popular Demand: FREE Technical Conference Admission for April 28th & 29th

FROM THE EDUCATION DIRECTOR

Certainly the 2026 TechCon in Long Beach feels like an eternity from now, but you can rest assure that planning is well underway! Since we all said goodbye in Nashville, we spent time assessing the program and thinking about new courses to offer. We learned that our offerings in Nashville continued to be well subscribed, with an average course enrollment that was comparable to the last few years. Several of our courses did quite well. For example, "Troubleshooting for Thin Film Deposition Processes" (C-212), taught by Mike Miller; "Diamond Like Carbon Coatings-From Basics to Industrial Realization" (C-320), taught by Lars Haubold, Christian Stein, and George Savva; "Application of Reactive Sputtering" (C-338), taught by Ralf Bandorf and Holger Gerdes; "Deposition Process Simulation" (M-250) taught by Dennis Barton; and "Materials for PVD Applications" (C-110) taught by Christos Pernagidis and Anas Ghailane all had outstanding attendance. The latter was a new course offering this year, which makes its large enrollment great to see. As for new courses in Long Beach, we are actively developing courses on topics that will help our members develop the skills needed to excel in our craft. And while the ink is not yet dry on our Long Beach program, we expect to exceed the 30 courses that were offered in Nashville. Stay tuned!

Since some of you reading this might have missed us this year, we remind you that most of our courses are offered in our "on-site" program, where the instructors come to teach their course in the comfort of your own facilities. Alternatively, we have a portfolio of "on demand" educational videos as well. So, if you have new employees who need training or "seasoned" ones who need a refresher, contact us to see how we can help meet your needs.

Whether you want to add to your skills or refresh your old ones, understand the technology or the science behind it, or look into emerging science and technology, I'm sure we have a course that satisfies your needs. To see a listing of all the courses and offering platforms, please visit the SVC website and follow the "education" link.

If you have some questions, please ask. We are always happy to help!

— Scott Walton, SVC Director of Education
scott.walton@svc.org

All paid TechCon conference registrants receive one complimentary seat in any tutorial and a 30% discount for any additional tutorials purchased.

About Our Venue

Long Beach Convention Center, Long Beach, California, USA

The 2026 TechCon will be held in the "Center" of Southern California... the Long Beach Convention & Entertainment Center. Located in the heart of Long Beach, the Convention Center is an urban waterfront destination. The building has an impressive architectural design, modern enhancements, and eye-catching décor. The glass dome of the Atrium provides illumination by sunlight in daytime and by colorful LED lights in the evening. The exhibit hall and meetings rooms are perfectly suited for the TechCon and our emphasis on networking and technical exchange. Overlooking bustling Rainbow Harbor, Queensway Bay, and Pacific Ocean beachfront, the Center sits in the middle of Long Beach's downtown waterfront, within walking distance to first-class accommodations, shopping, dining, attractions, sightseeing along picturesque bays, and 5 1/2 miles of sandy beach. Long Beach is convenient to Los Angeles International, Long Beach, and Orange County Airports.

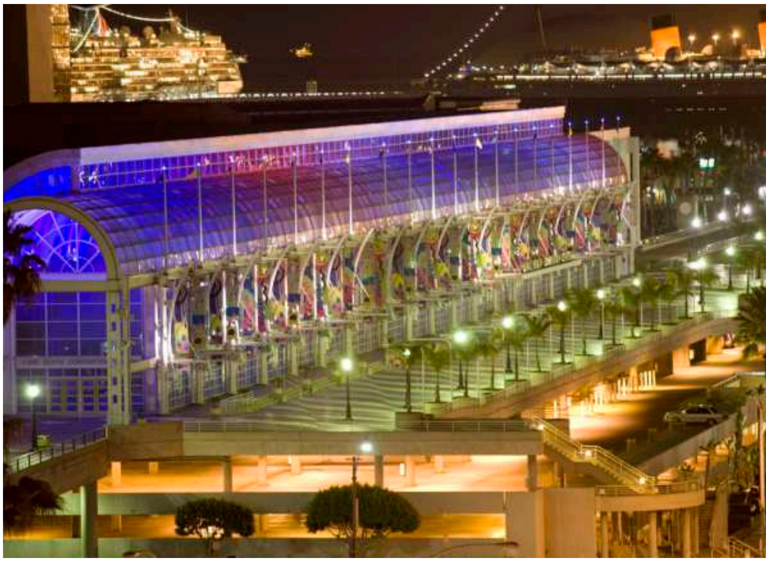
Room blocks and discounted rates have been organized for TechCon attendees. These accommodations are available at:

- $309 USD (double occupancy) - Hyatt Regency Long Beach Hotel, 200 S. Pine Avenue, Long Beach, CA 90802

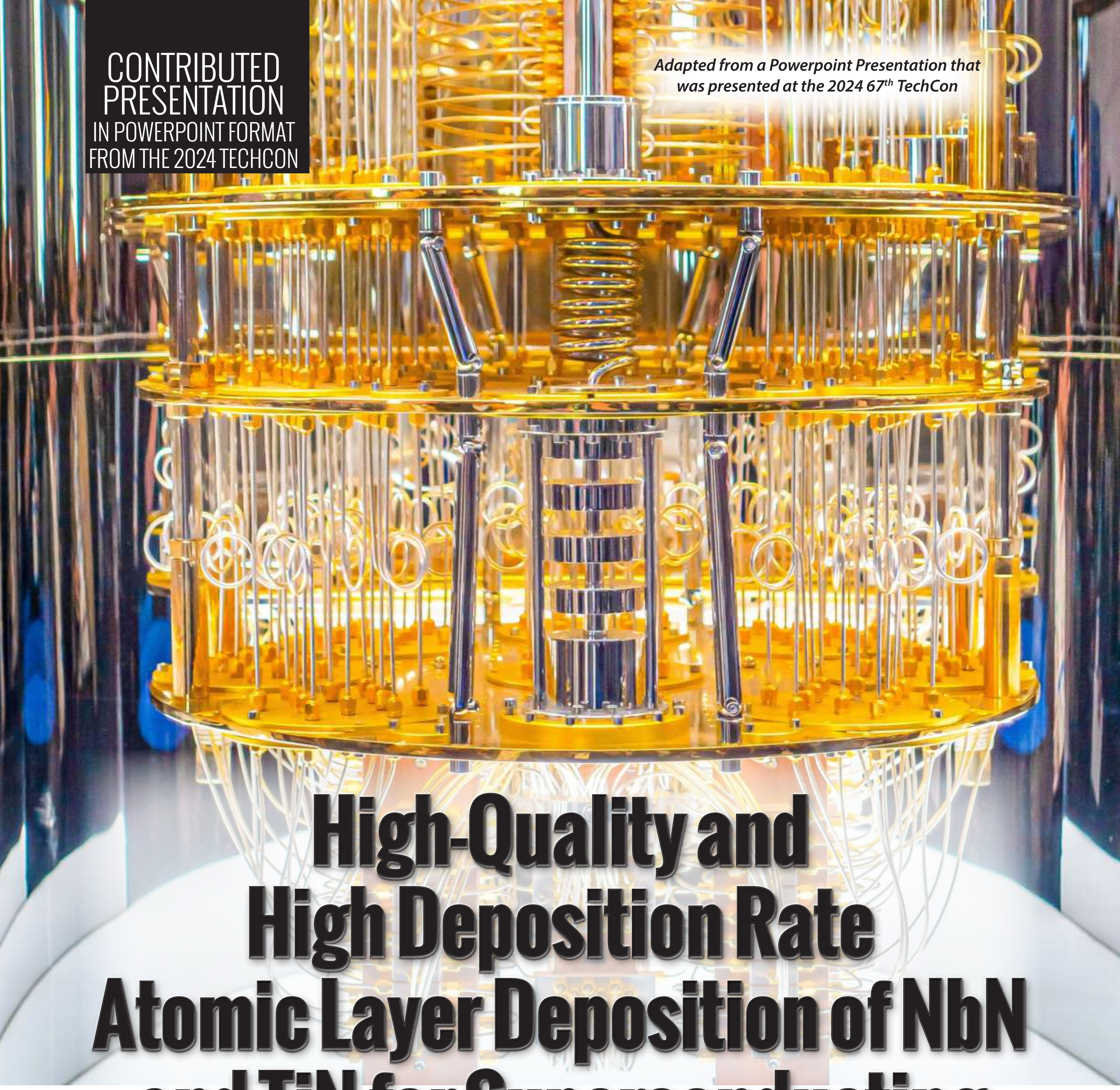
  Located on a premier waterfront spot in the heart of downtown, Hyatt Regency Long Beach is the only 4 Diamond Award-winning Long Beach, California, hotel with all 531 rooms and suites offering ocean or harbor views. The Hyatt Regency Long Beach is connected directly to the Long Beach Convention Center and will house the majority of the TechCon's social events as well as meeting space/classrooms for the TechCon TFB and tutorial programs.

- $319 USD (double occupancy) - Hyatt Centric The Pike Long Beach Hotel, 285 Bay St, Long Beach, CA 9080

  Hyatt Centric The Pike Long Beach pays homage to the fascinating history of The Pike, an amusement park founded in 1902 that was a thriving destination for its bathhouse, wooden roller coaster, arcades and exciting family fun until 1979. This luxe hotel possesses a rooftop pool and bar with 360° panoramic views, places you in the middle of the neighborhood action so you can explore Long Beach's bustling shopping areas, non-stop nightlife and the rolling surf of California's Pacific Ocean. The hotel is a two-minute walk from the Long Beach Convention Center.



Important note! Discounted room rates are available **exclusively** on the dedicated hotel pages that will be accessible on the SVC 2026 TechCon registration site. ***The SVC does not engage with any third-party companies to provide hotel accommodations.*** Be aware that in all cases, organizations representing themselves as affiliated with the SVC when it comes to hotel accommodations for the TechCon are likely to have malicious motives leading to a nefarious outcome if you rely on them.



CONTRIBUTED PRESENTATION
IN POWERPOINT FORMAT FROM THE 2024 TECHCON

Adapted from a Powerpoint Presentation that was presented at the 2024 67th TechCon

High-Quality and High Deposition Rate Atomic Layer Deposition of NbN and TiN for Superconducting Quantum Applications

By Harm Knoops[1,2], Dmytro Besprozvannyy[1], Louise Bailey[1], Michael Powell[1], Silke Peeters[2], Lisa Nelissen[2], Erwin Kessels[2], Russ Renzas[1]

[1]Oxford Instruments Plasma Technology, Bristol, United Kingdom

[2]Eindhoven University of Technology, Eindhoven, Netherlands

HIGH-QUALITY AND HIGH DEPOSITION RATE ATOMIC LAYER DEPOSITION OF NBN AND TIN FOR SUPERCONDUCTING QUANTUM APPLICATIONS

Due to the potential of excellent film control, uniformity, and conformality, atomic layer deposition (ALD) is seen as very promising for quantum devices where interface and material quality and their uniformities are a big challenge. Furthermore, for superconducting circuits, the deposition rate of ALD can be an issue since sufficient film thickness (> 50 nm) is needed to minimize kinetic inductance effects on resonator frequency and the shielding effectiveness of superconducting vias for crosstalk mitigation depends on film thickness and film conformality in the 3D structures. The challenge here is to deliver a sufficiently fast processes while maintaining the desired film properties and benefits of ALD.

Here, we will share our recent development of a new remote plasma ALD system providing high-quality superconducting NbN and TiN for quantum applications at rates > 25 nm/hour, which is approximately 3x faster than previously reported. The RF-driven remote plasma source design and chamber of our ALD system are optimized to enable this high deposition rate.

The quality of the deposited films was demonstrated to be excellent, as measured by four-point probe electrical resistivity, conformality (100% on 8:1 trench for NbN, verified by SEM), and superconducting transition temperature (Tc). Good superconducting properties of the film were demonstrated by SQUID measurements. A thickness non-uniformity of < ±5% across a 150 mm Si wafer was achieved with good repeatability. Both NbN and TiN films show cubic crystalline structure as confirmed by XRD measurements. We will also show how stress can be tuned as a function of process parameters, such as the RF source power and discuss film composition, stoichiometry and purity levels such as carbon and oxygen. We will also touch upon how ALD is well-suited to combine processes and provided ternary films such as NbTiN.

Emerging quantum technologies based on superconducting nitride materials are showing great promise and will benefit not only from the uniformity of the deposition, conformality and film quality, but also from the speed and control provided by ALD processes on this system.

Note from Managing Editor: We are delighted to share with the readers of the Bulletin some of the interesting Powerpoint Presentations from past TechCons. We hope you find them as interesting as we do.

Sue Taube/Managing Editor

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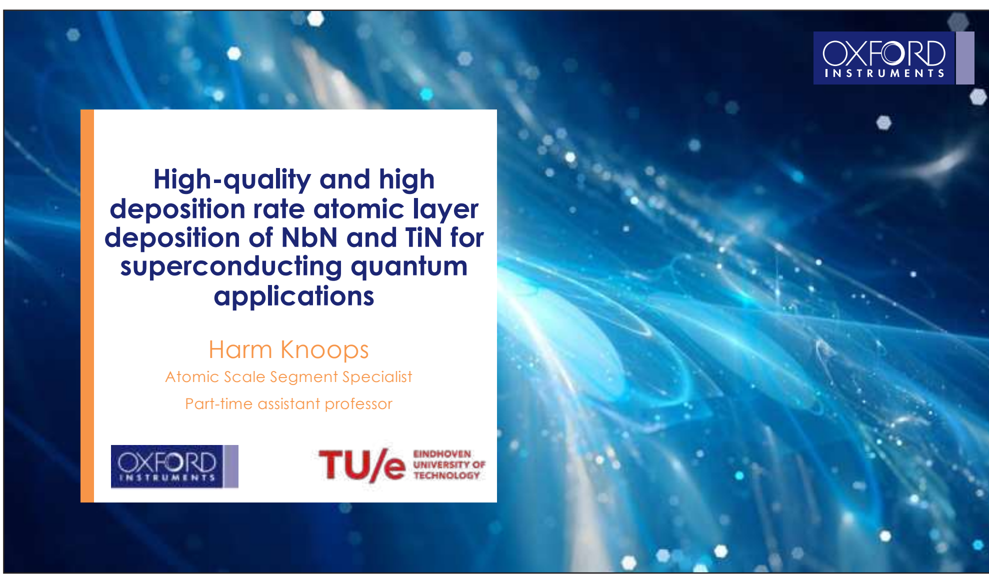
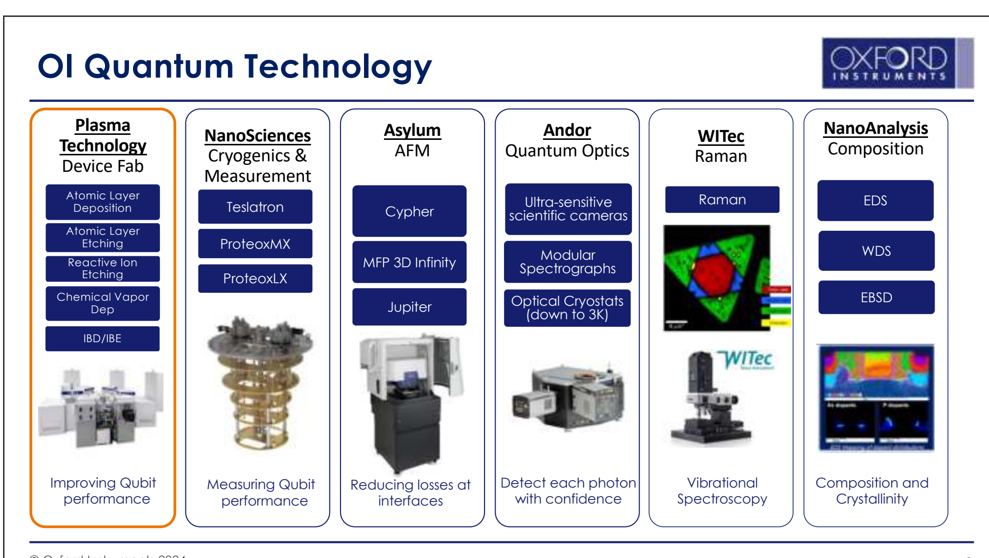
https://www.svc.org

DOI: https://doi.org/10.14332/svc24.proc.0001





HIGH-QUALITY AND HIGH DEPOSITION RATE ATOMIC LAYER DEPOSITION OF NBN AND TIN FOR SUPERCONDUCTING QUANTUM APPLICATIONS

Outline

- Context and background
- **Why ALD for quantum**
  - High-quality nitrides by plasma ALD
  - Fast ALD of superconducting TiN and NbN
  - Using supercycles for NbTiN
- Conclusion

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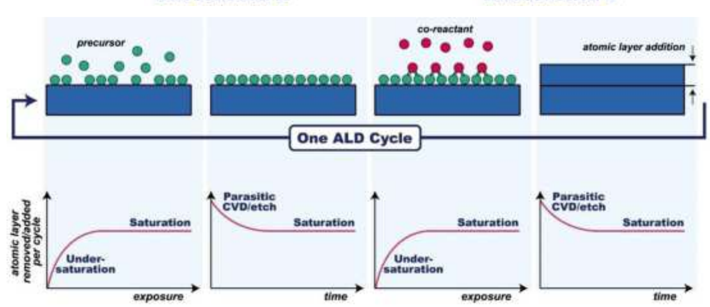
What is atomic layer deposition (ALD)

ALD is a conformal self-limiting process which builds films by depositing an atomic layer upon atomic layer.

Advantages of ALD

- Growth control at the sub-nanometer level
- Uniformity of the films on large substrates
- Conformality for complex surface features



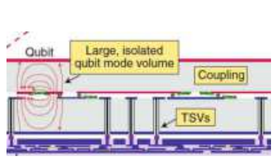
Faraz et al., *J. Solid State Sci. Technol.* **4**, N5023 (2015) 5

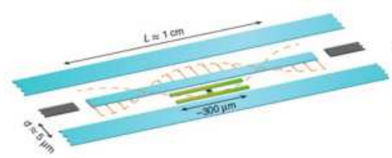
ALD for superconducting circuits

Through silicon vias (TSVs)
TSVs through interposer decouple Qubit and interconnects. 3D integration needed for qubit interconnects.

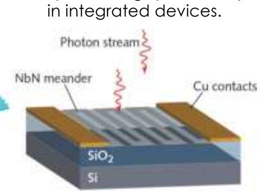
Superconducting resonators
Read-out and control of qubits. General test vehicle for improving qubits.

Superconducting nanowire single photon detectors (SNSPDs)
Single photon detectors are enabling elements of performing quantum operations in integrated devices.





Blais et al., Nature Physics 16, 2020, 247



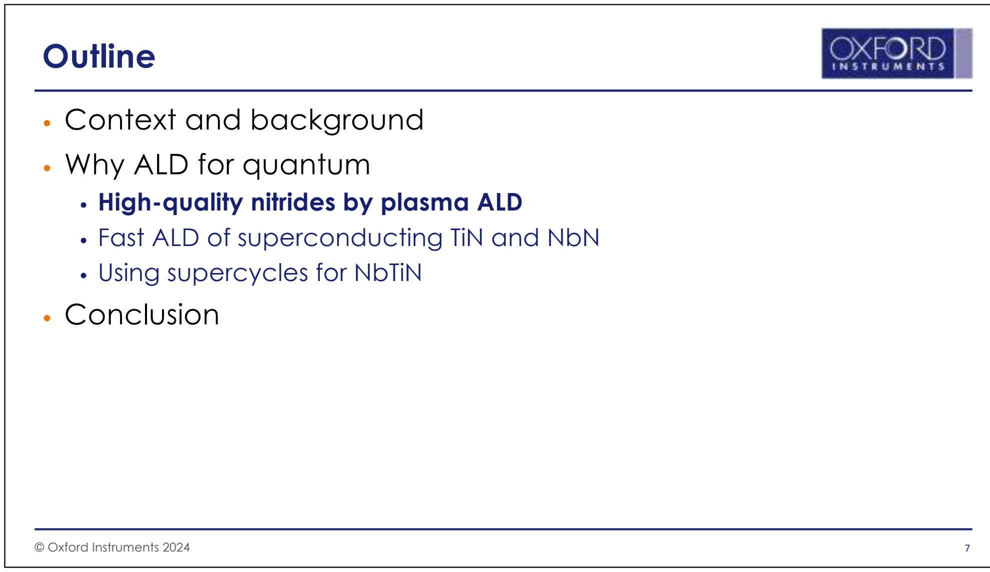
Vorobyov et al., Opt. Mat. Exp. 7, 513 (2017)

Challenge to obtain superconducting conformal layers in 3D structures.

High-quality interfaces and surfaces are essential to obtain high quality factors.

Uniform ultra-thin (~5 nm) superconducting layers needed to have high performance and reproducibility.

See blog about **ALD and ALE go Quantum** on www.AtomicLimits.com by Silke Peeters 6


Outline
OXFORD INSTRUMENTS
• Context and background
• Why ALD for quantum
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• Conclusion
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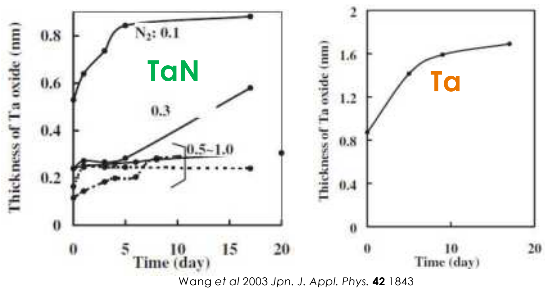
HIGH-QUALITY AND HIGH DEPOSITION RATE ATOMIC LAYER DEPOSITION OF NBN AND TIN FOR SUPERCONDUCTING QUANTUM APPLICATIONS

Nitrides exhibit less oxidation than metals

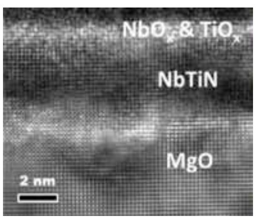
Sputtered TaN_x reduced oxidation vs Ta



Wang *et al* 2003 *Jpn. J. Appl. Phys.* **42** 1843

TEM of sputtered 4 nm NbTiN film oxidized in air for a few days → only limited oxidation

NbTiN



Zhang et al. Physica C: Superconductivity and its applications 545 (2018): 1-4.

- Metal-nitride compounds exhibit limited surface oxidation (compared to pure metals such as Nb and Ta)
- Film quality, stoichiometry, and phase crucial for oxidation resistance →**deposition method important**

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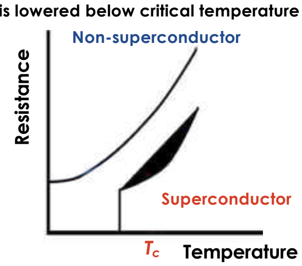
Critical temperature T_c for metals and nitrides

Superconductivity appears when temperature is lowered below critical temperature T_c



T_c values of metals and their nitrides (common materials in bold)

Metal	T_c (K)	Ref	Nitride	T_c (K)	Ref
Al	1.2	1	-	-	
Hf	0.4	1	HfN	6-9	1
Mo	0.9	1	MoN	4-14	1
Nb	9.3	1	**NbN**	9-16	1,2
NbTi	10	4	**NbTiN**	15-16	2
Ta	4.5	1	TaN	6-8	3
Ti	0.5	1	**TiN**	3-5	1

- Nitrides have relatively high critical temperature (T_c) for superconductivity compared to pure metals.
- T_c can depend strongly on crystal phase and other material properties → **deposition method important**

Many more references exist, but these were used:

1. Flores-Livas et al., Physics Reports 856 (2020) 1–78
2. Iosad et al., IEEE Trans. Appl. Supercon. 11, 3832 (2001)
3. Kilbane and Habig, JVST 12, 107 (1975)
4. Scanlan et al., Proc. IEEE 2004, 92,1639

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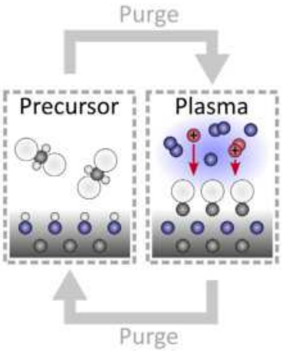
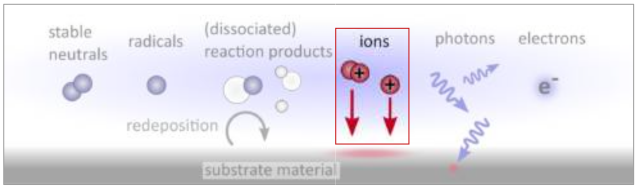
Plasma-assisted atomic layer deposition



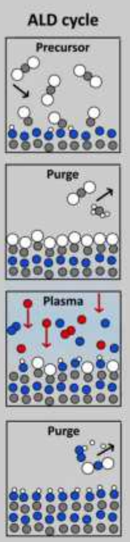
Plasma-assisted atomic layer deposition



- Properties of plasma step can have a big influence on resulting material properties.

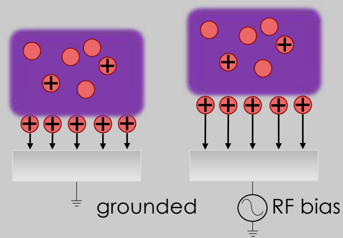
TU/e EINDHOVEN UNIVERSITY OF TECHNOLOGY

Knoops et al., *J. Vac. Sci. Technol. A* **37**, 030902 (2019)
Arts et al., *Plasma Sources Sci. Technol.* **31**, 103002 (2022) 10



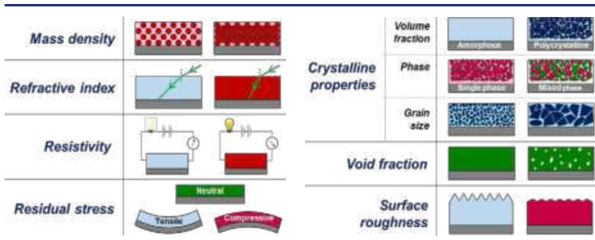
Energetic ions in PEALD

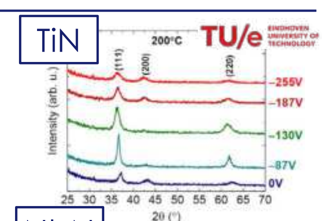
- In PEALD ions can influence the material growth
- The effect of ions strongly depends on processing conditions, such as plasma source design and pressure.
- The ion energy can be enhanced using radio-frequency (RF) substrate biasing



Arts *et al.*, Plasma Materials and Processing group 11

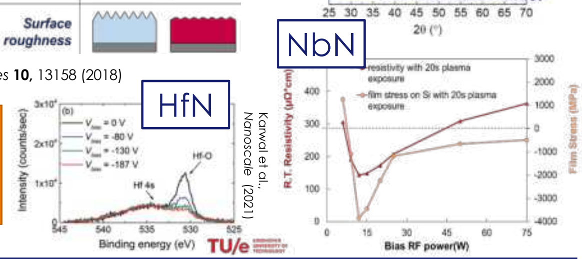
Effect of substrate bias on film properties





Faraz et al., *ACS Appl. Mater. Interfaces* **10,** 13158 (2018)

Bias improves conductive nitrides
- Shorter plasma exposure times
- Lower deposition temperatures
- Crystallinity & O-content control
- Faster Deposition Rate



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Outline

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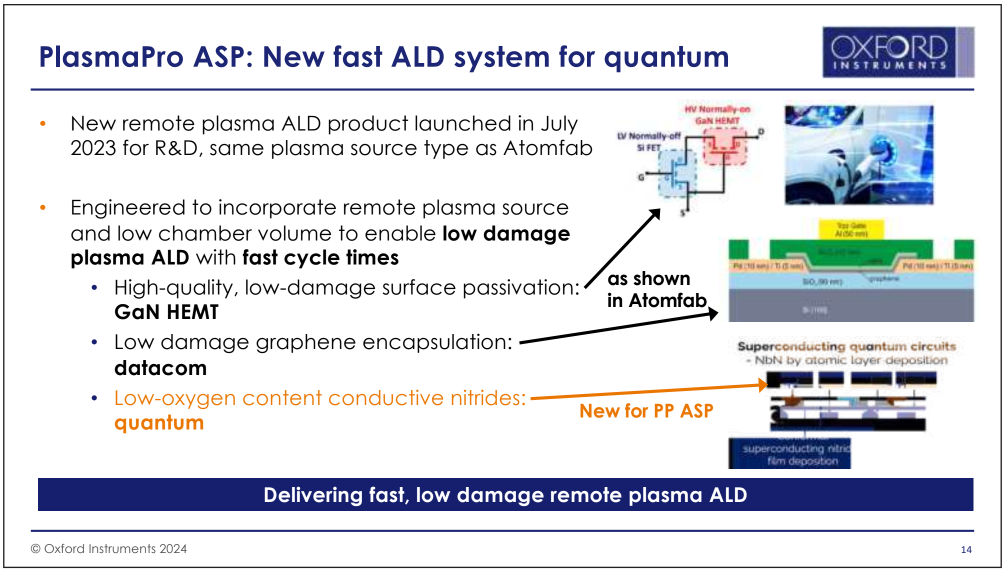
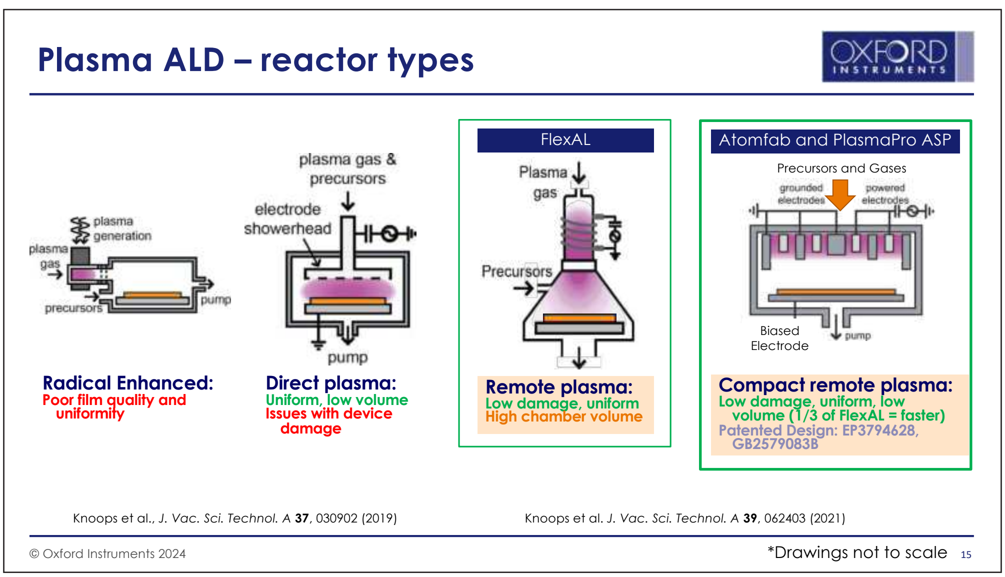
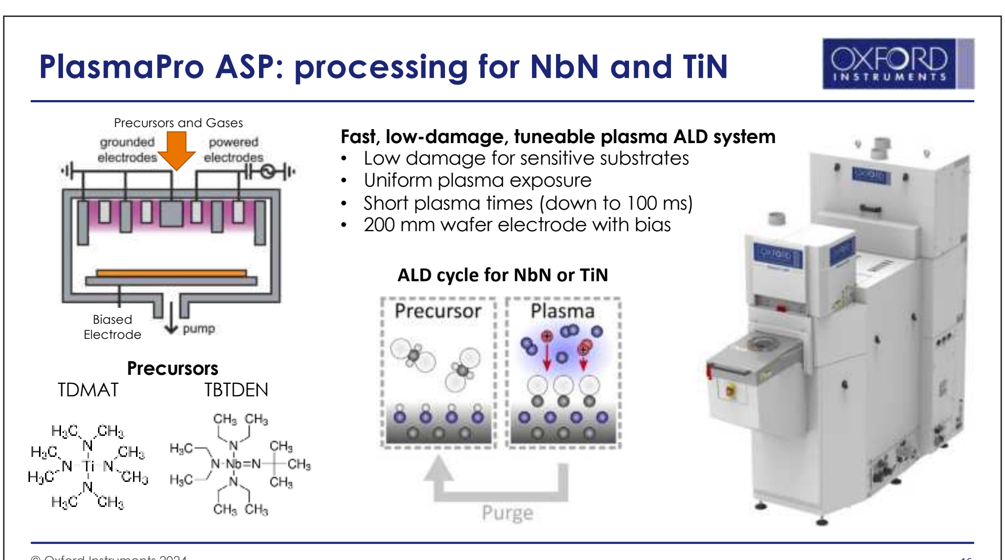
HIGH-QUALITY AND HIGH DEPOSITION RATE ATOMIC LAYER DEPOSITION OF NBN AND TIN FOR SUPERCONDUCTING QUANTUM APPLICATIONS







TiN process results

OXFORD INSTRUMENTS

Parameter	Specification
Deposition temp. (°C)	< 400 °C
Deposition Rate	> 35 nm/hr
Uniformity (%) [max-min]	< ±3% at 40 nm (based on ellipsometry)
Resistivity	< 250 μ.ohm.cm at 40 nm < 150 μ.ohm.cm at 100 nm
Conformality	80% in 15:1 trench (≈ 7:1 via) (measured on side wall and bottom)
Stress	< 2.5 GPa for 40 nm
T_c	> 3.0 K for 100 nm, > 2.0 K for 40 nm
Repeatability (%)	< ±1%
Cleaning	> 2.5 μm between mechanical cleans

All Specified Results Obtained in Single Process
150 mm wafer, 5 mm edge exclusion

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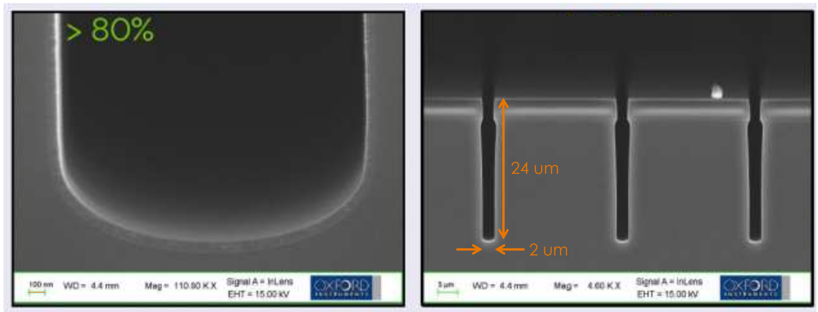
HIGH-QUALITY AND HIGH DEPOSITION RATE ATOMIC LAYER DEPOSITION OF NBN AND TIN FOR SUPERCONDUCTING QUANTUM APPLICATIONS

Conformality: 100 nm TiN in 12:1 Trench



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NbN process results

Parameter	Specification
Deposition temp. (°C)	< 400 °C
Deposition Rate	> 25 nm/hr
Uniformity (%) [max-min]	< ±5.0% at 25 nm (based on ellipsometry)
Resistivity	< 250 µ.ohm.cm
Conformality	> 75% in 12:1 trench (≈ 6:1 via) (measured on side wall and bottom)
Stress	< 1.5 GPa for 100 nm NbN
T_c	> 11 K for 50 nm NbN
Repeatability (%)	< ±1%
Cleaning	> 2.5 µm between mechanical cleans

All Specified Results Obtained in Single Process
150 mm wafer, 5 mm edge exclusion

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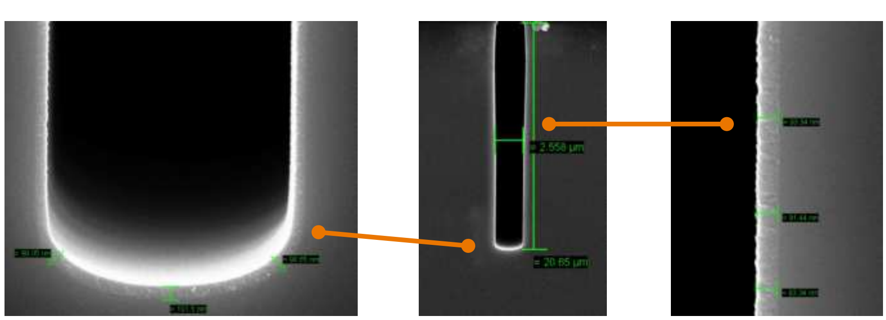
Conformality: 100 nm NbN in 8:1 Trench



> 90% Conformality

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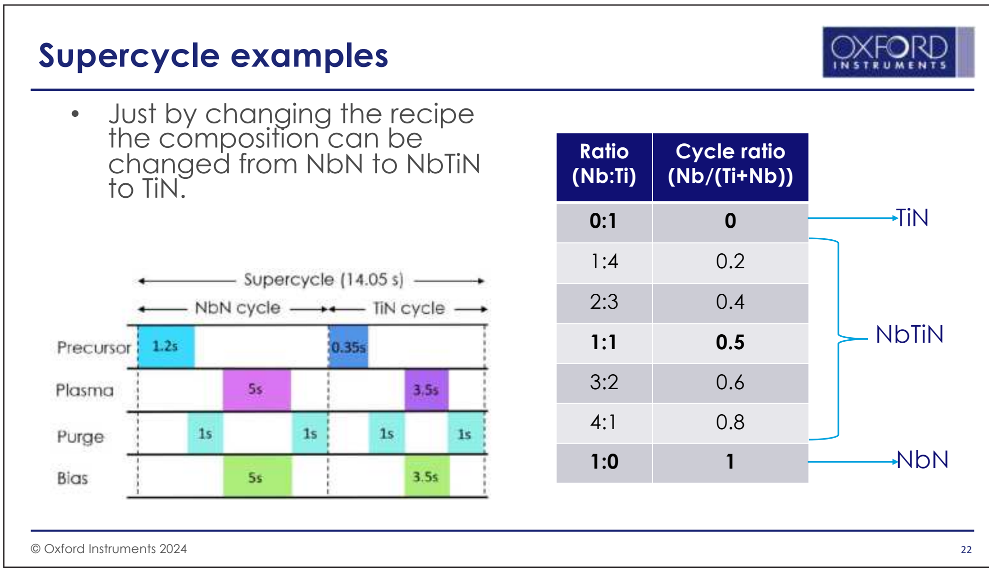

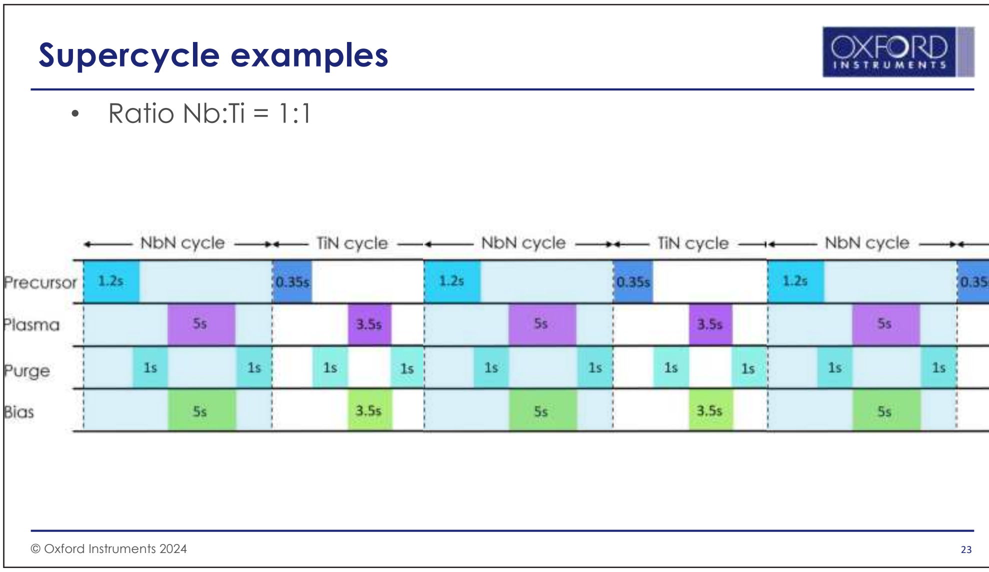
Supercycle examples
OXFORD INSTRUMENTS
• Ratio Nb:Ti = 1:1
NbN cycle
TiN cycle
NbN cycle
TiN cycle
NbN cycle
Precursor
Plasma
Purge
Bias
1.2s
0.35s
5s
3.5s
1s
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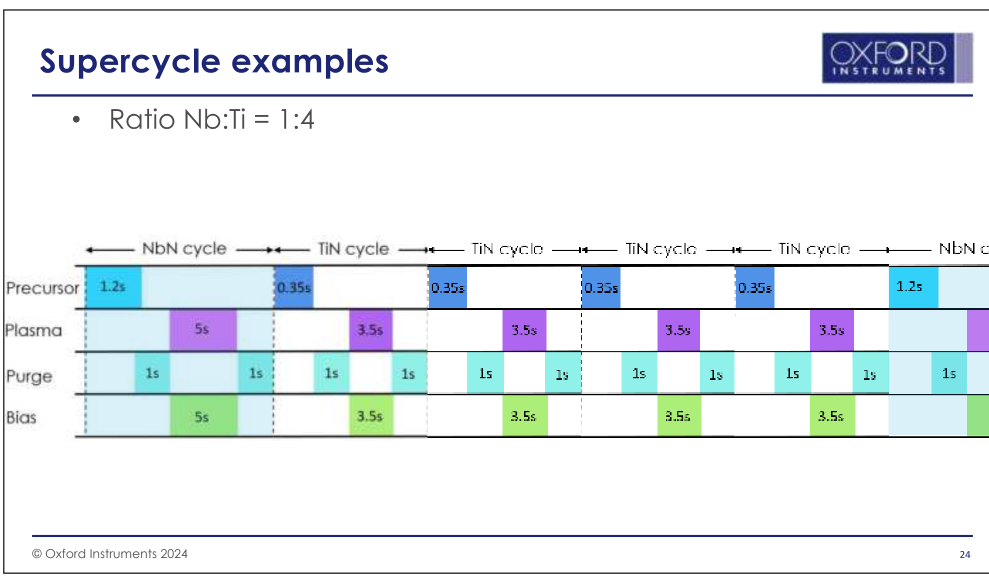
Supercycle examples
OXFORD INSTRUMENTS
• Ratio Nb:Ti = 1:4
NbN cycle
TiN cycle
TiN cycle
TiN cycle
TiN cycle
Precursor
Plasma
Purge
Bias
1.2s
0.35s
5s
3.5s
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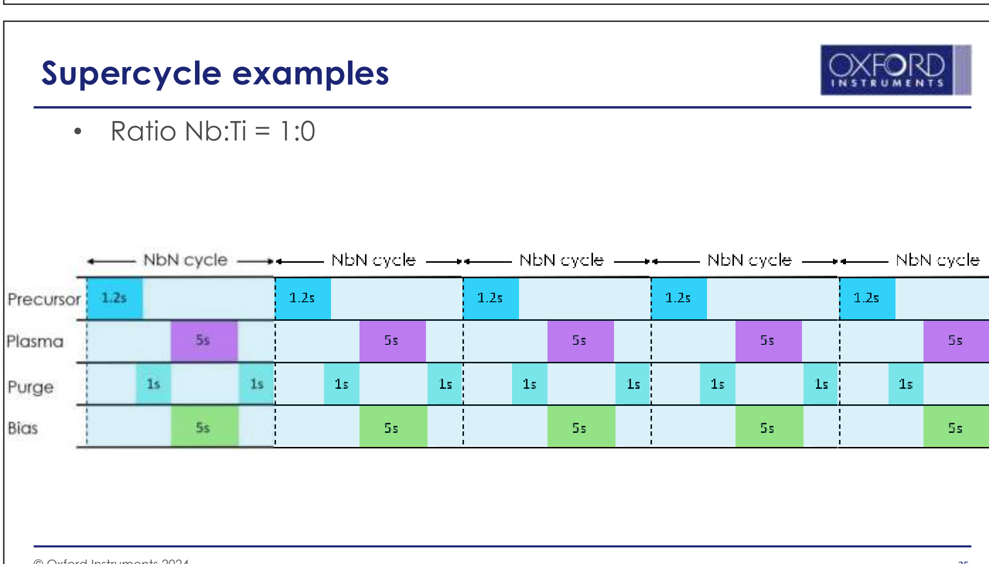
Supercycle examples
OXFORD INSTRUMENTS
• Ratio Nb:Ti = 1:0
NbN cycle
NbN cycle
NbN cycle
NbN cycle
NbN cycle
Precursor
Plasma
Purge
Bias
1.2s
5s
1s
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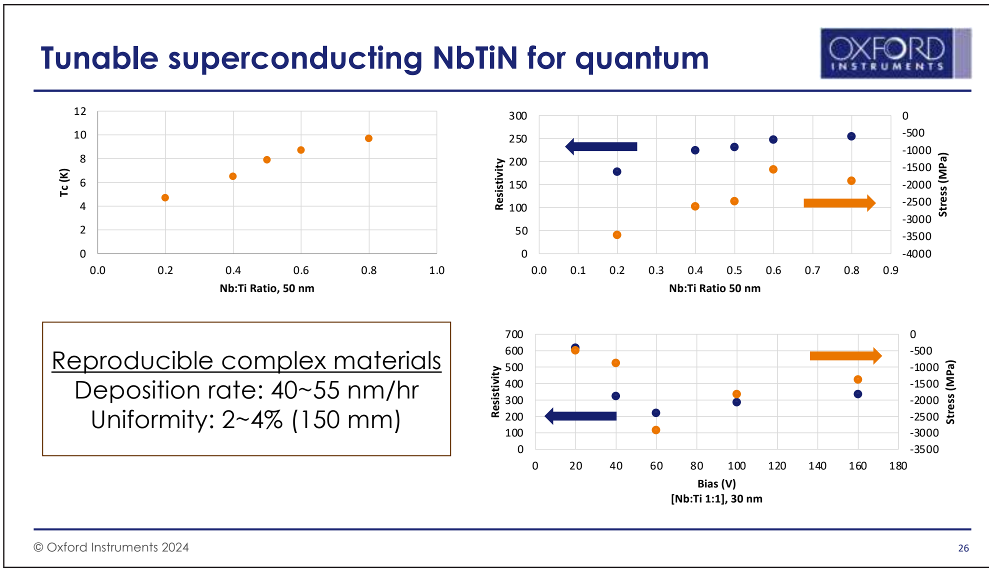
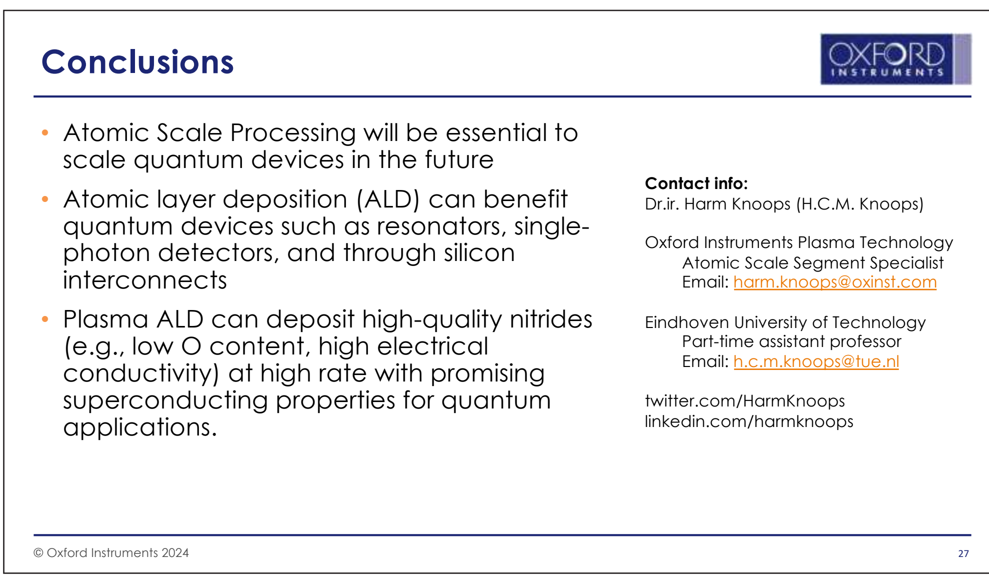
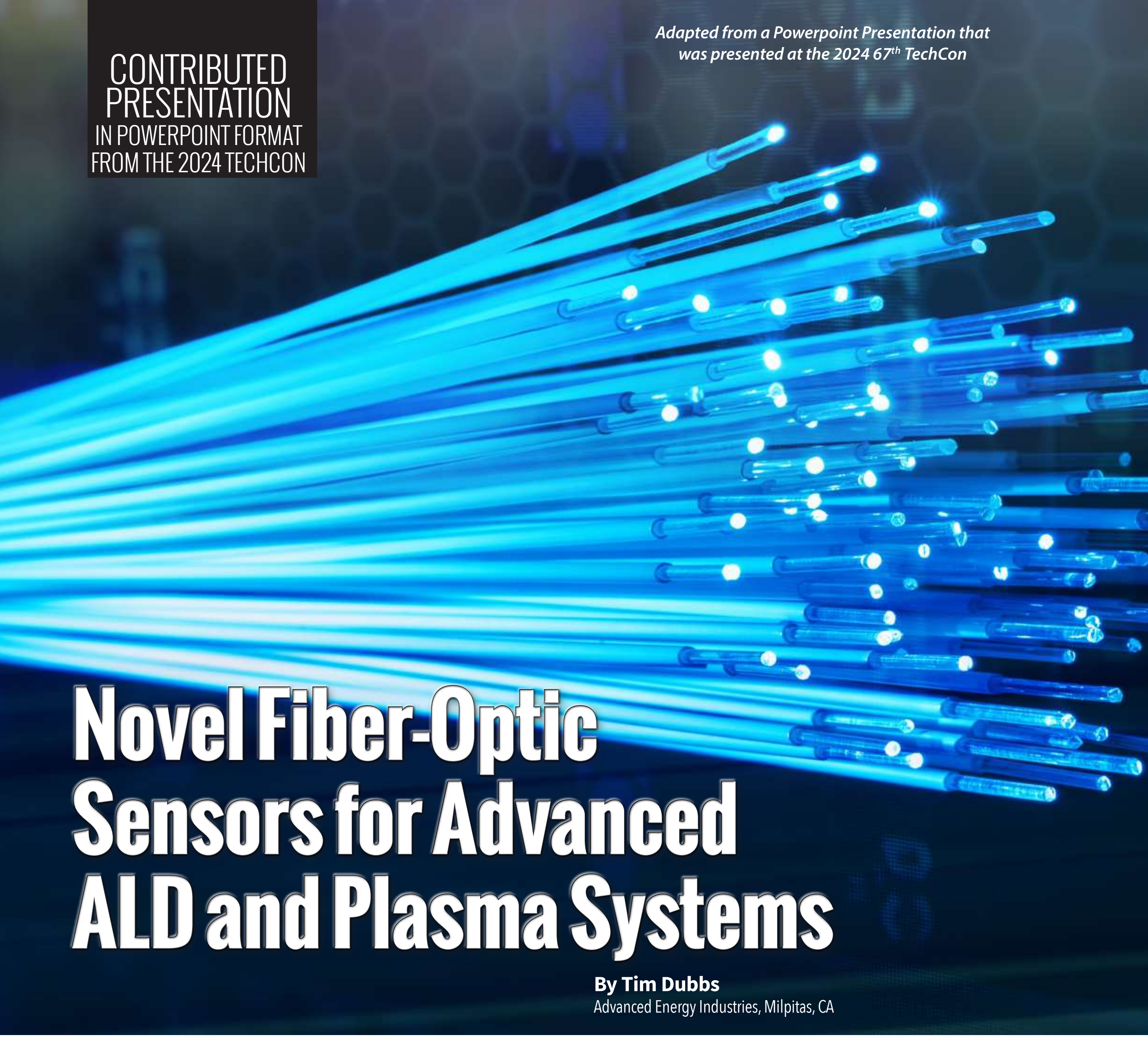
HIGH-QUALITY AND HIGH DEPOSITION RATE ATOMIC LAYER DEPOSITION OF NBN AND TIN FOR SUPERCONDUCTING QUANTUM APPLICATIONS





About the Author:
Harm Knoops

Harm Knoops is the Atomic Scale Segment Specialist at Oxford Instruments Plasma Technology and holds a part-time assistant professorship position at the Eindhoven University of Technology. His work covers the fields of (plasma-based) synthesis of thin films, advanced diagnostics and understanding and developing plasma ALD, plasma ALE and growth of 2D materials. His main goals are to improve and advance atomic scale processes and applications for Oxford Instruments and its customers.



CONTRIBUTED PRESENTATION
IN POWERPOINT FORMAT
FROM THE 2024 TECHCON

Adapted from a Powerpoint Presentation that was presented at the 2024 67th TechCon

Novel Fiber-Optic Sensors for Advanced ALD and Plasma Systems

By Tim Dubbs
Advanced Energy Industries, Milpitas, CA

Complex systems for coatings, deposition and etch often require precise temperature measurement and control for improved product yields. Other critical parameters may include process pressures, gas line temperatures and chamber wall temperature or strain as a safety concern. Cost-effective, field-proven fiber optic sensing solutions provide significant advantages over other sensor technologies in these demanding environments.

CONTRIBUTED PRESENTATION IN POWERPOINT FORMAT FROM THE 2024 TECHCON

HIGH-QUALITY AND HIGH DEPOSITION RATE ATOMIC LAYER DEPOSITION OF NBN AND TIN FOR SUPERCONDUCTING QUANTUM APPLICATIONS

Fiber optic sensors are inherently immune to electromagnetic interference from RF, induction, and microwave sources. They can also be shielded from plasma light interferences to provide stable and accurate measurements. No sensor calibration is required over the design lifetime with minimum fatigue, resulting in lower cost of ownership. Multiple sensors and mixed sensing parameters, such as temperature and strain/pressure can be used on a single fiber optic cable thus reducing the complexity of installations and greatly increasing the density of measurement points. In addition, the fiber optic sensors are ideally suited for ALD and Etch applications, providing excellent accuracy from cryogenic temperatures to 450°C. In this presentation, Advanced Energy will review the status of fiber optic sensor technologies including phosphor decay, Fiber Bragg Gratings, Fabry Perot interferometry and infrared fiber pyrometry, followed by highlights of application solutions for ALD, PECVD and Plasma Etch systems including installation and performance advantages of these sensors.

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Sue Taube/Managing Editor

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DOI: https://doi.org/10.14332/svc24.proc.0002

Novel Fiber Optic Sensors for Advanced ALD & Plasma Systems

Tim Dubbs Ph.D.

Director Applications Engineering
Advanced Energy – CSC Photonics

Agenda

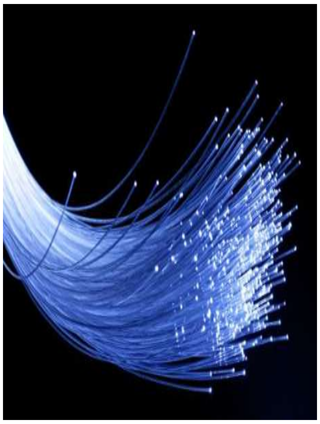
01 Advantages of Fiber Optics

02 Fiber Sensor Technologies
- I) Phosphor Decay
- II) Fiber Bragg Gratings
- III) Fabry Perot

03 Example Sensors

04 Applications

05 Summary



3

Advantages of Fiber Optic Sensors

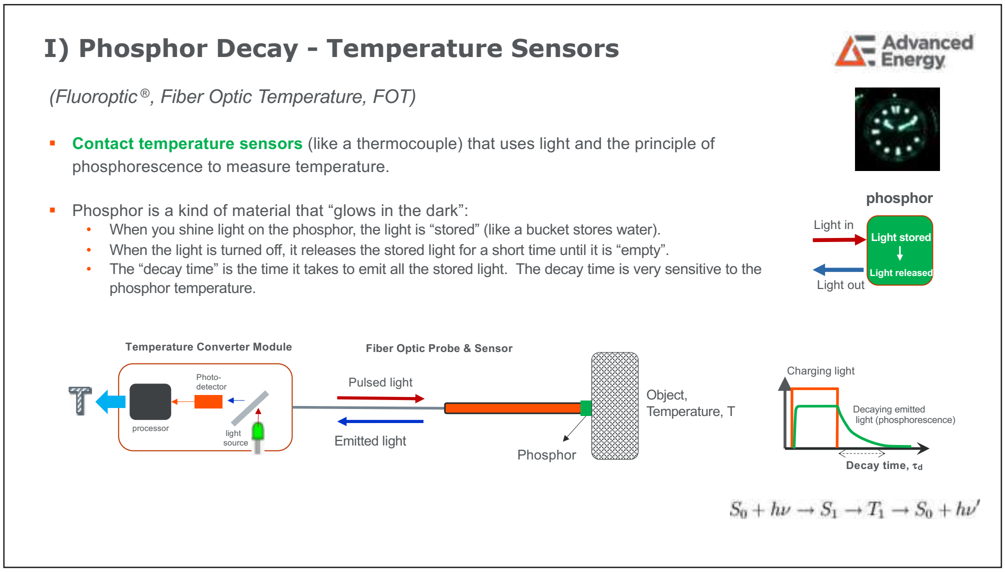
Fiber optics sensors are not just for communications
There are many mainstream sensors available today

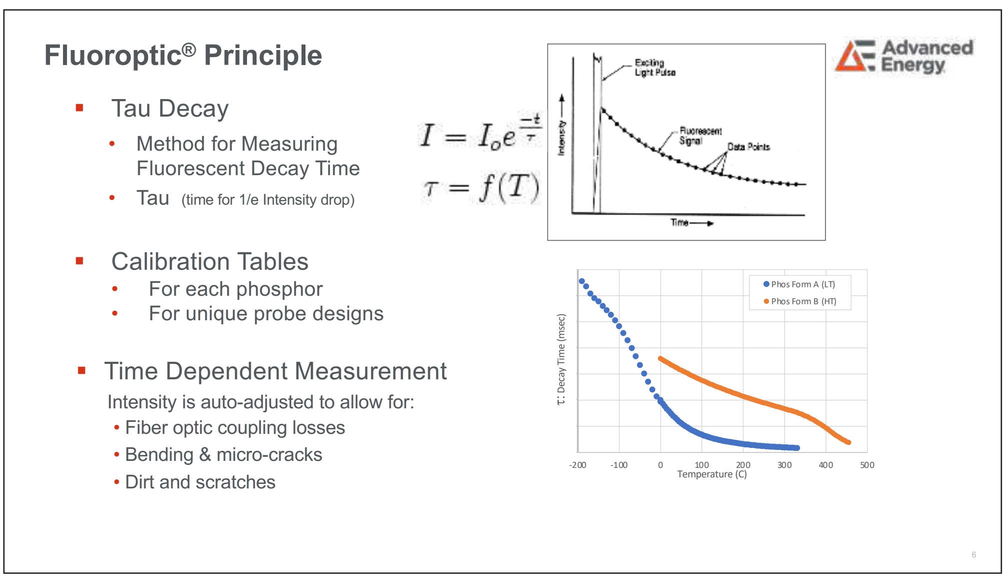
Performance Advantages:
- Immune to external electromagnetic interference (RF, Microwave, Induction, HV)
- Flexible & robust, with minimal mechanical fatigue
- Often require no further calibration
- Small diameters, minimal length constraints
- Multiple measurands (Temperature, Strain, Pressure, Deflection)
- Multiplexing sensors on single fiber
- Competitive Performance

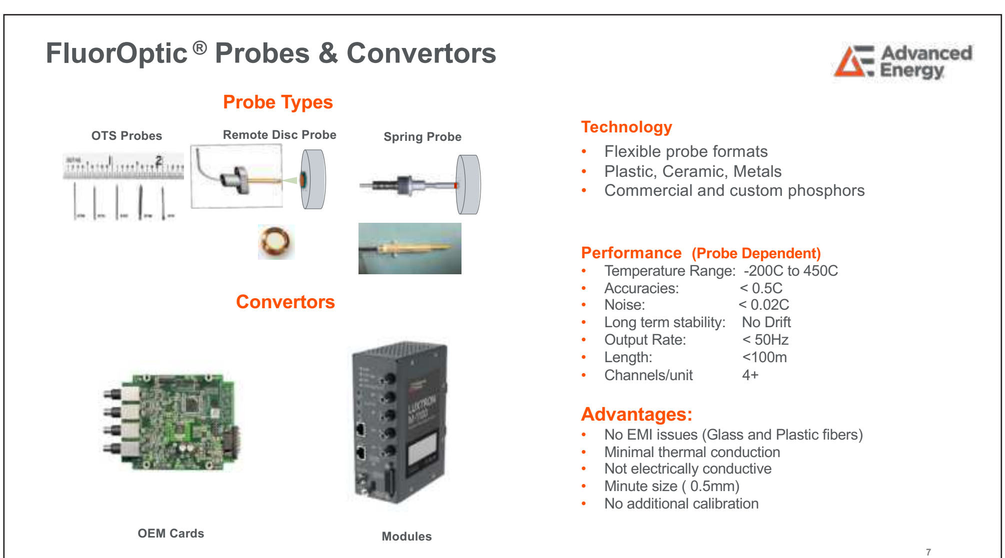
Commercial Advantages:
- Mature Technologies, multiple vendors.
- Expanding suppliers driving costs down
- Minimal Calibration/Service costs

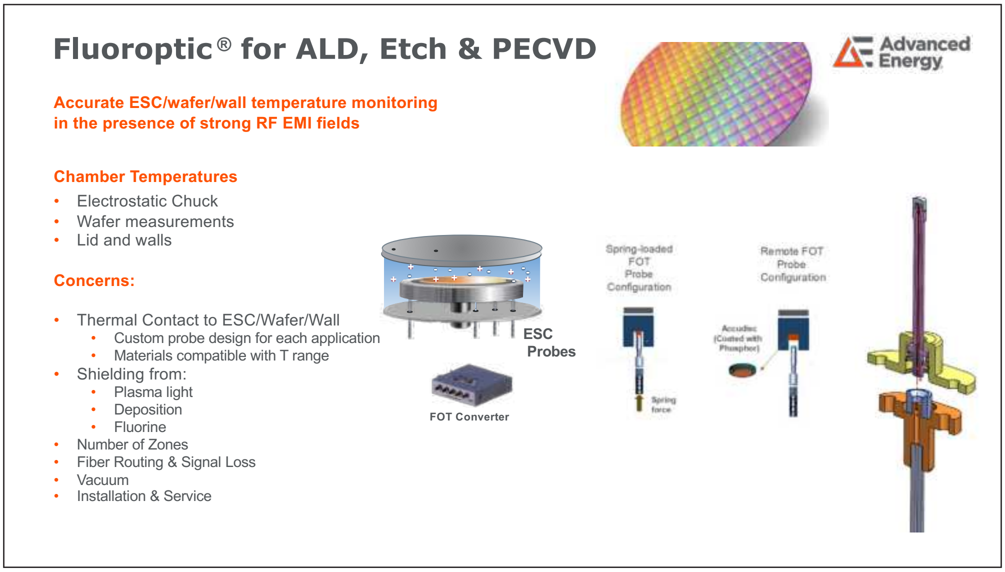
4

HIGH-QUALITY AND HIGH DEPOSITION RATE ATOMIC LAYER DEPOSITION OF NBN AND TIN FOR SUPERCONDUCTING QUANTUM APPLICATIONS

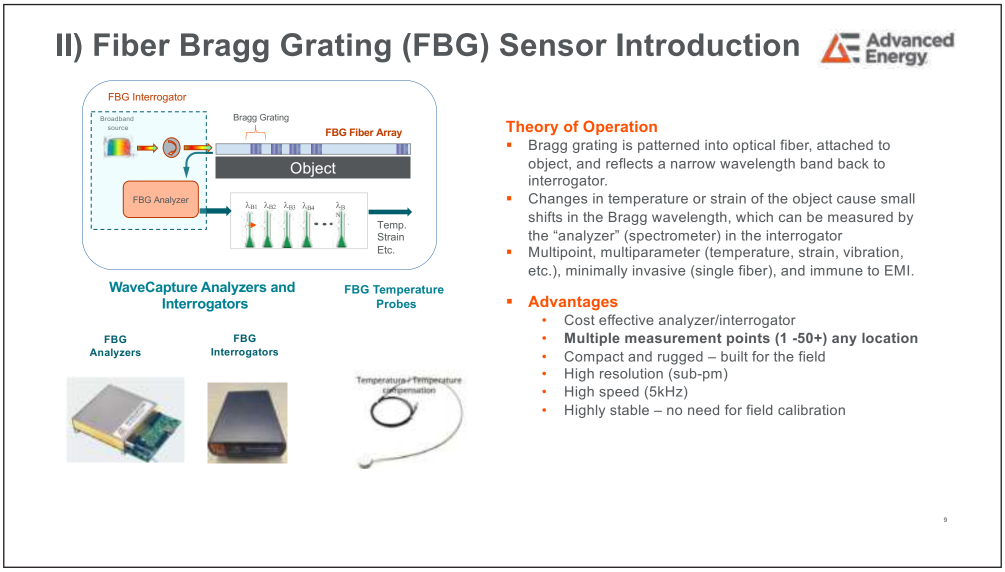


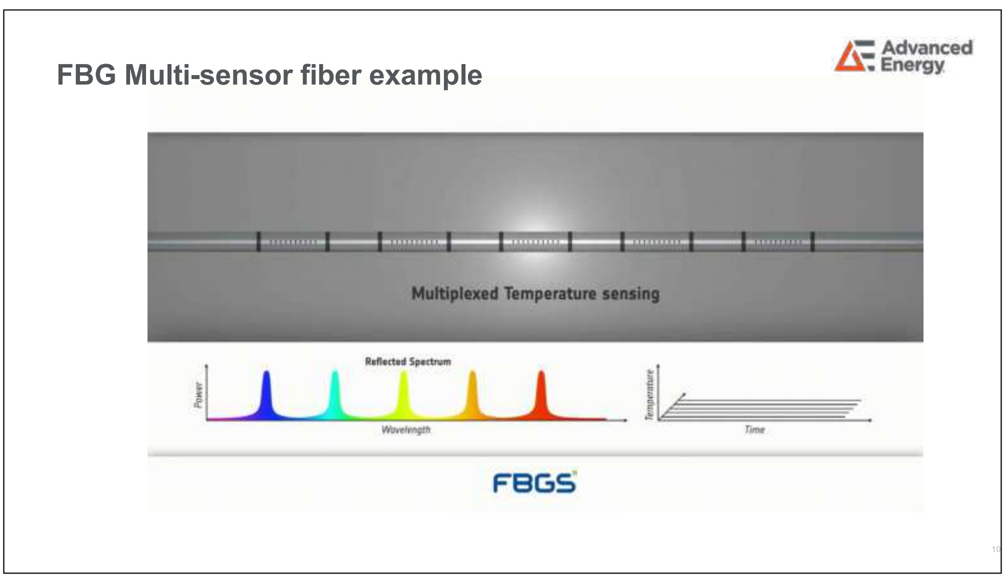


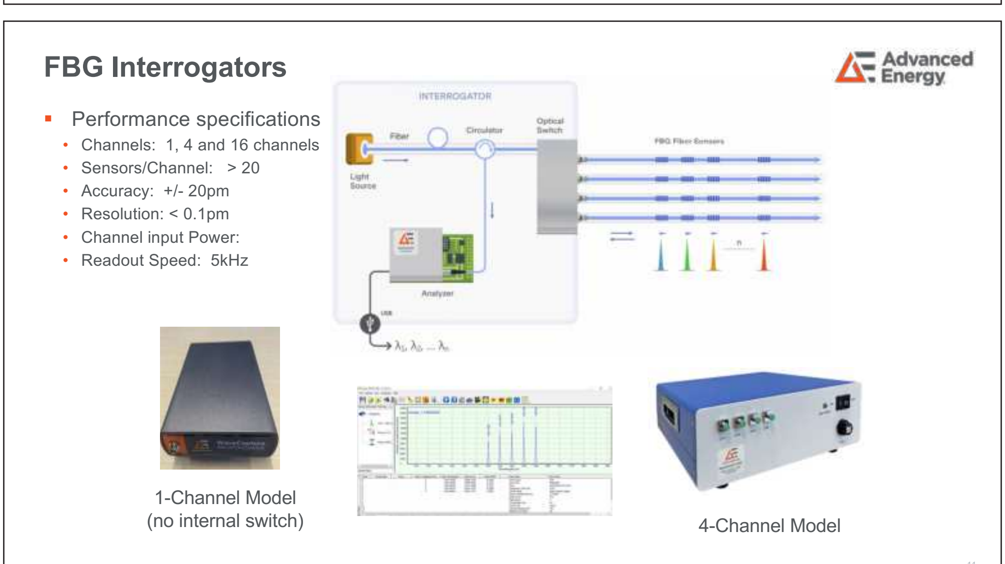


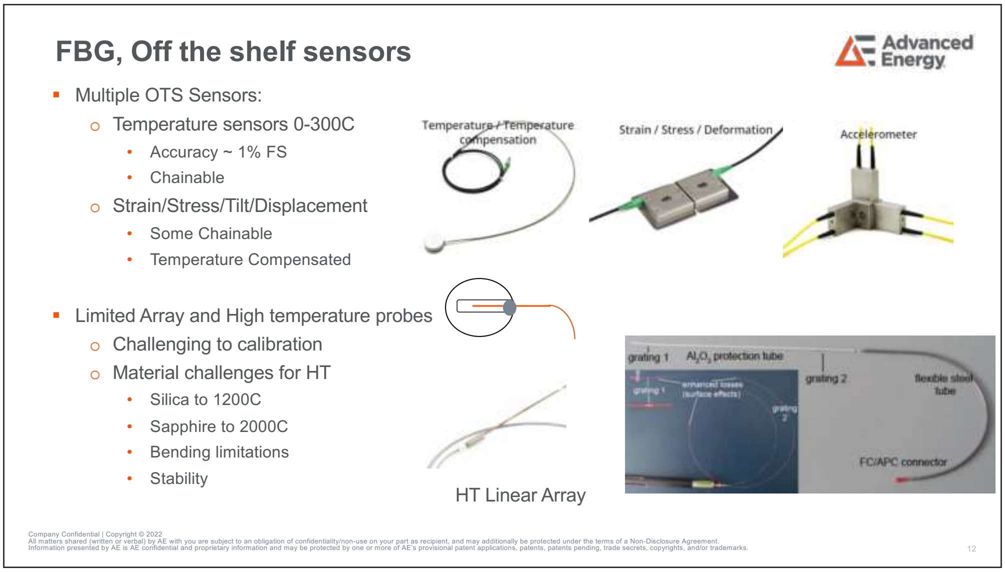

Fluoroptic® for ALD, Etch & PECVD
Advanced Energy
Accurate ESC/wafer/wall temperature monitoring
in the presence of strong RF EMI fields
Chamber Temperatures
• Electrostatic Chuck
• Wafer measurements
• Lid and walls
Concerns:
• Thermal Contact to ESC/Wafer/Wall
• Custom probe design for each application
• Materials compatible with T range
• Shielding from:
• Plasma light
• Deposition
• Fluorine
• Number of Zones
• Fiber Routing & Signal Loss
• Vacuum
• Installation & Service
ESC
Probes
FOT Converter
Spring-loaded FOT Probe Configuration
Remote FOT Probe Configuration

HIGH-QUALITY AND HIGH DEPOSITION RATE ATOMIC LAYER DEPOSITION OF NBN AND TIN FOR SUPERCONDUCTING QUANTUM APPLICATIONS








FBG, Off the shelf sensors
Advanced Energy
Multiple OTS Sensors:
Temperature sensors 0-300C
Accuracy ~ 1% FS
Chainable
Strain/Stress/Tilt/Displacement
Some Chainable
Temperature Compensated
Limited Array and High temperature probes
Challenging to calibration
Material challenges for HT
Silica to 1200C
Sapphire to 2000C
Bending limitations
Stability
Temperature / Temperature compensation
Strain / Stress / Deformation
Accelerometer
grating 1
Al_2O_3 protection tube
grating 2
flexible steel tube
FC/APC connector
HT Linear Array
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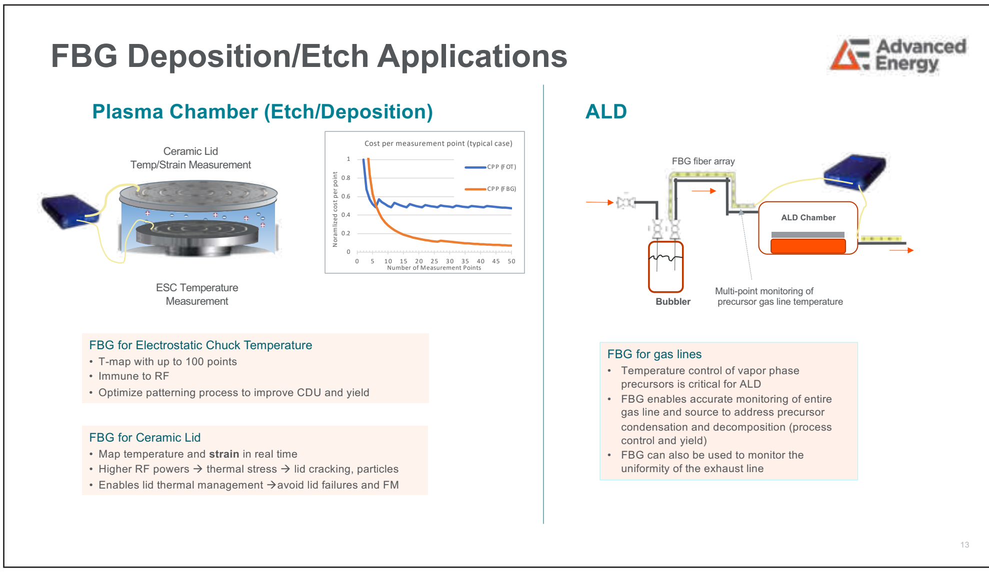
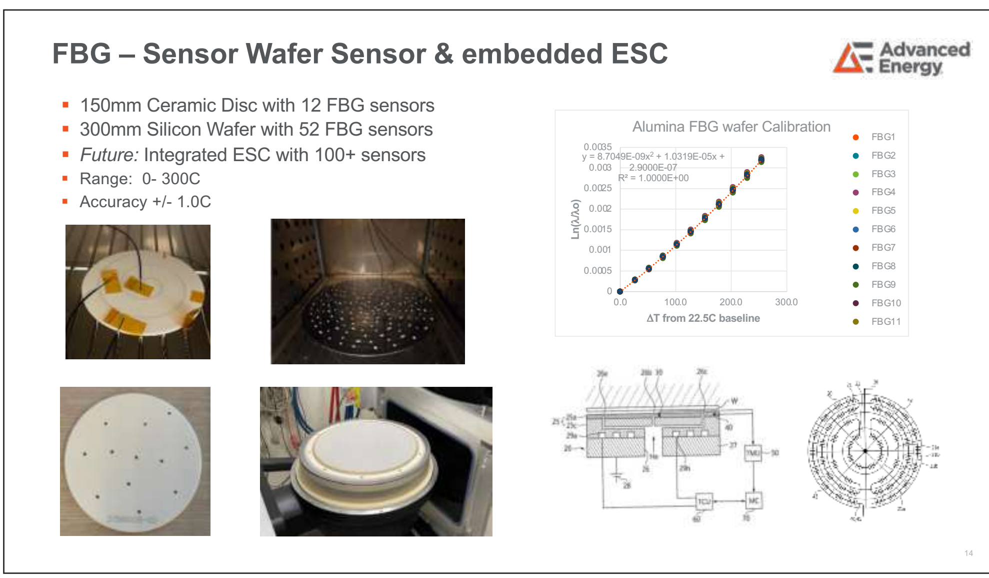
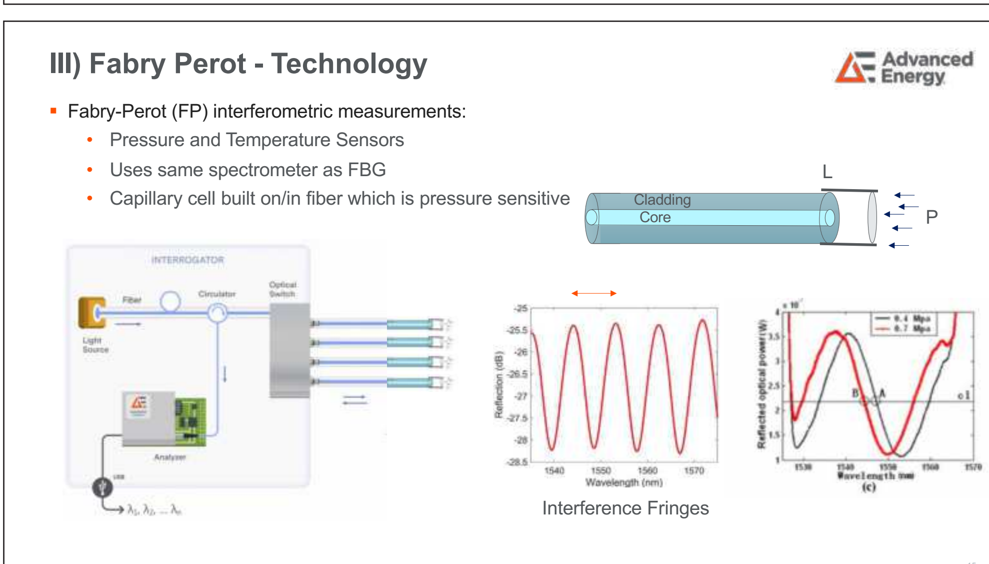
HIGH-QUALITY AND HIGH DEPOSITION RATE ATOMIC LAYER DEPOSITION OF NBN AND TIN FOR SUPERCONDUCTING QUANTUM APPLICATIONS





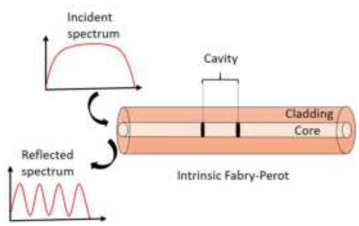


HIGH-QUALITY AND HIGH DEPOSITION RATE ATOMIC LAYER DEPOSITION OF NBN AND TIN FOR SUPERCONDUCTING QUANTUM APPLICATIONS

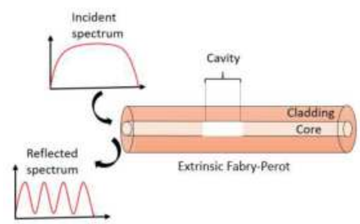
Fiber Optic Fabry-Perot Sensors

Advanced Energy

- **Intrinsic Fabry-Perot**
  Application: Temperature sensing

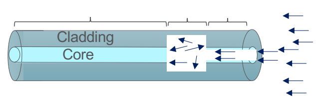


- **Extrinsic Fabry-Perot**
  Application: Pressure sensing



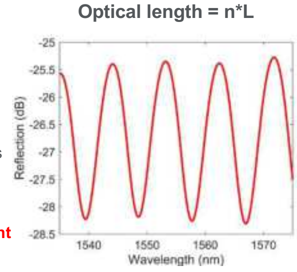
Extrinsic Fiber Optic Fabry-Perot Sensor

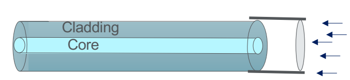
Advanced Energy



- Change the number of gas molecules inside the cavity, which changes the density (refractive index)
- Refractive index alters the optical length of the cavity
- No changes of cavity length as optical fiber has very large Young's modulus
- **Sensitivity depends on the number of gas molecules present in the cavity**

Optical length = n*L

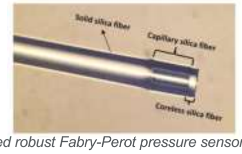




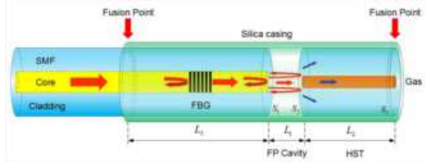
- Change the diaphragm shape, which in turns change the cavity length.
- Length alters the optical length of the cavity
- No changes of refractive index as cavity is closed
- **Sensitivity depends on the diaphragm material and its thickness**

Extrinsic Fiber Optic Fabry-Perot Sensors

Advanced Energy



All silica based robust Fabry-Perot pressure sensor (in-house fabrication) 62.5um fiber



- Commercial Pressure Sensors:
  - Range: -6 psi to 7 psi
  - Resolution: 0.01 psi
- Extrinsic Robust
  - Range: -10 to ~400 psi
  - Thinner the diaphragm, higher the sensitivity (but limits range)
  - Resolution: 0.05 psi
- Side cavity based on RI change can cover a range of 0 – 1kpsi

Fiber Optics - Conclusions

Advanced Energy

- Fiber Optic Sensors are now commonplace for advanced technologies such as deposition and etch.
  - Temperature, Strain, Pressure, Deflection
- Immune to interference from RF, Microwave, Induction, High Voltage.
- Multiple sensing techniques can be used on the same fiber (Temperature & Strain & Pressure)
- Cost effective, Minimal wear, Minimal/No Calibration

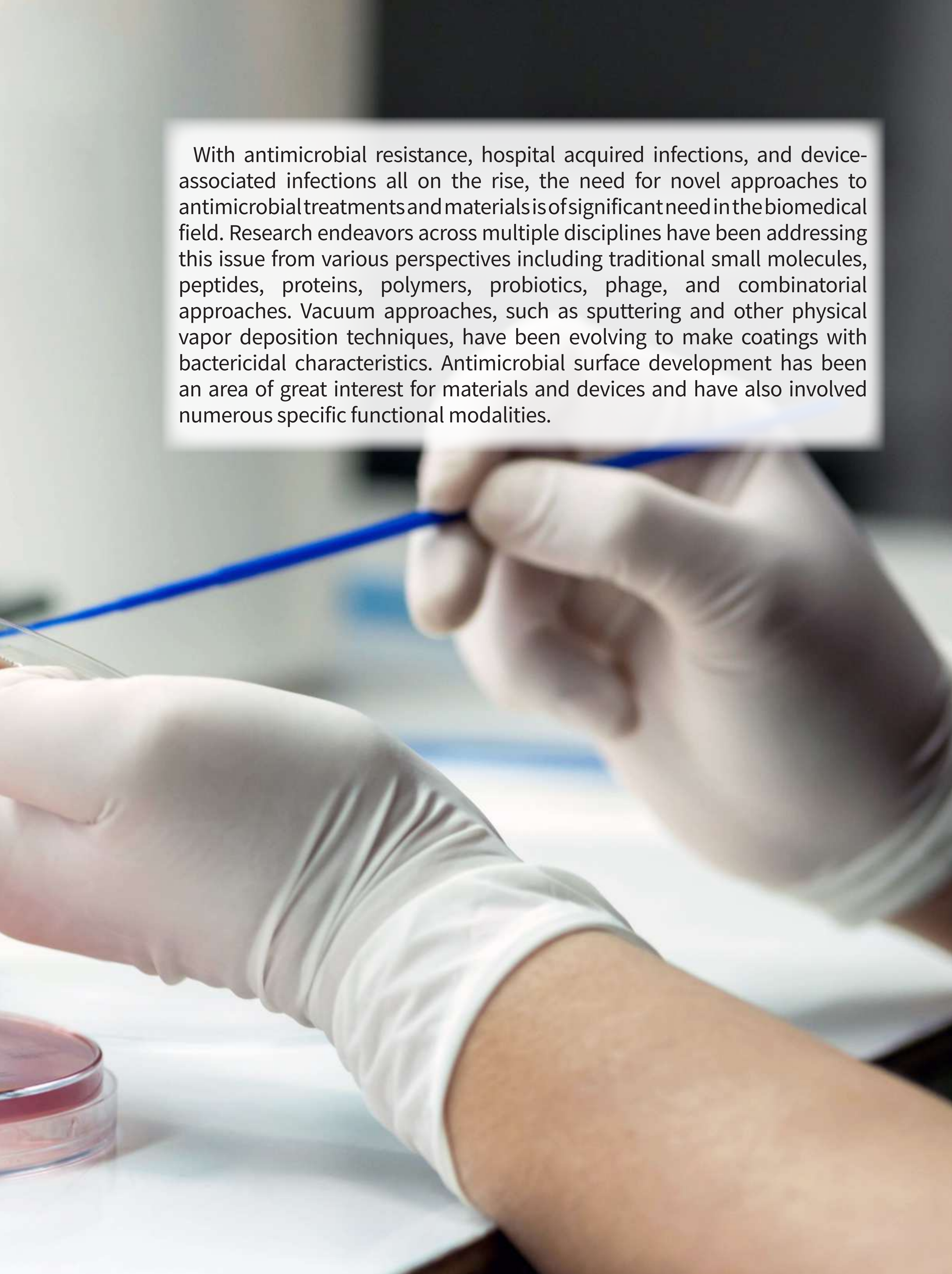
CONTRIBUTED PRESENTATION IN POWERPOINT FORMAT FROM THE 2024 TECHCON

Adapted from a Powerpoint Presentation that was presented at the 2024 67th TechCon

A Hitchhiker's Guide to Antimicrobial Thin Film Coatings

By Gregory A. Caputo
Rowan University, Glassboro, NJ

With antimicrobial resistance, hospital acquired infections, and device-associated infections all on the rise, the need for novel approaches to antimicrobial treatments and materials is of significant need in the biomedical field. Research endeavors across multiple disciplines have been addressing this issue from various perspectives including traditional small molecules, peptides, proteins, polymers, probiotics, phage, and combinatorial approaches. Vacuum approaches, such as sputtering and other physical vapor deposition techniques, have been evolving to make coatings with bactericidal characteristics. Antimicrobial surface development has been an area of great interest for materials and devices and have also involved numerous specific functional modalities.



CONTRIBUTED PRESENTATION IN POWERPOINT FORMAT FROM THE 2024 TECHCON

A HITCHHIKER'S GUIDE TO ANTIMICROBIAL THIN FILM COATINGS

Our team has focused on the development of metal based, thin film coatings for medical device applications, specifically bone/joint implants, and electrostimulation devices. Testing the bactericidal activity of these vacuum applied coatings require modifications to traditional biochemical testing techniques. After modifying the testing techniques, we have shown that these coatings demonstrate remarkable broad-spectrum antimicrobial activity, high bioavailability of the active compounds to interact with bacterial targets, minimal cytotoxicity, and retention of conductivity properties essential in electrostimulators. The coatings are versatile, with significant tunability to tailor the active component release profiles to the application of the material.

Our current approaches and results will be discussed, with a focus on the antimicrobial methodology used to evaluate the efficacy of antibacterial activity specifically on vacuum applied coatings. These techniques will also be discussed regarding their potential role in the investigation of nature-inspired topographies controlling biofilm adhesion. In general, these updated or modified assays will be discussed to describe how they can interact and synergize with traditional surface/materials characterization approaches to enhance the understanding of antimicrobial mechanisms.

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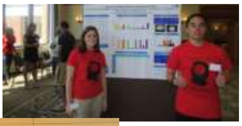
https://www.svc.org DOI: https://doi.org/10.14332/svc24.proc.0004

A Hitchhiker's Guide to Antimicrobial Thin Film Coatings

Gregory A. Caputo
Rowan University

The credit first

- Sarah Goderecci (MS)
- CJ Medina (BS)
- Fallon Waechter (BS)
- Dan Ammerman (BS)
- Josh Lee (BS)
- Hailey Maurer
- Matt Urban (BS?)
- Luke Hicks
- Max Marano
- Arwa Muhamed

- Jeff Hettinger
- Bob Krchnavek
- Lei Yu
- Val Carabetta
- Ted Scabarozi
- Jon Foglein

So why a hitchhikers guide?

- I am not a microbiologist
- I have never taken a microbiology class
- I am not a materials scientist
- I DID take one materials science class as an undergrad ☺

So why a hitchhikers guide?

- I spent my career working on molecules that KILL bacteria, so I picked up some tricks along the way

Table 1. Estimates of Costs and LOS Attributed to the 5 Major Health Care-Associated Infections for the US Adult Inpatient Population at Acute Care Hospitals[a]

Health Care-Associated Infection Type	Cost, 2012 $US	LOS (as Total, ICU), d
Surgical site infections	20 785 (18 902-22 667)[b]	11.2 (10.5-11.9)[b]
MRSA	42 300 (4005-82 670)[b]	23.0 (14.3-31.7)[b]
Central line-associated bloodstream infections	45 814 (30 919-65 245)[b,c]	10.4, 6.9 (6.9-15.2, 3.5-9.6)[b,c]
MRSA	58 614 (16 760-174 755)[c]	15.7 (7.9-36.5)[c]
Catheter-associated urinary tract infections	896 (603-1189)[b]	NR
Ventilator-associated pneumonia	40 144 (36 286-44 220)[b,c]	13.1, 8.4 (11.9-14.3, 7.8-9.0)[b,c]
Clostridium difficile infections	11 285 (9118-13 574)[b]	3.3 (2.7-3.8)[b]

Abbreviations: ICU, intensive care unit; LOS, length of hospital stay; MRSA, methicillin-resistant *Staphylococcus aureus*; NR, not reported.

Table 2. Epidemiology of Health Care-Associated Infections Among US Adult Inpatients (Including ICUs) at Acute Care Hospitals, 2009[a]

Health Care-Associated Infection Type	Incidence Rate	Population at Risk	Cumulative Incidence
Surgical site infections	1.98[b]	8 020 658	158 639
MRSA	0.29[b]	8 020 658	23 417
Central line-associated bloodstream infections	1.27[c]	31 695 922	40 411
MRSA	0.21[c]	31 695 922	6638
Catheter-associated urinary tract infections	1.87[c]	41 115 000	77 079
Ventilator-associated pneumonia	1.33[c]	23 392 785	31 130
Clostridium difficile infections	3.85[d]	34 716 079	133 657
Total health care-associated infections	NA	NA	440 916

Abbreviations: ICU, intensive care unit; MRSA, methicillin-resistant *Staphylococcus aureus*; NA, not applicable.

patient procedures.

[c] Incidence rate in cases per 1000 device-days; population at risk in total

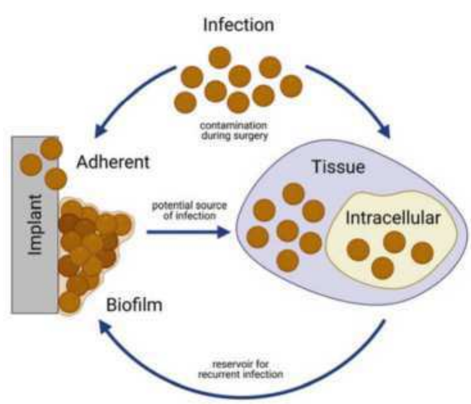
Table 3. Total Attributable Financial Impacts of Health Care-Associated Infections in US Adult Inpatients at Acute Care Hospitals, 2009[a]

Health Care-Associated Infection Type	Costs		
	Total	Lower Bound	Upper Bound
Surgical site infections	3 297 285 451	2 998 570 584	3 595 841 680
MRSA	990 539 052	93 785 080	1 935 883 296
Central line-associated bloodstream infections	1 851 384 347	1 249 464 195	2 636 608 279
MRSA	389 081 519	111 253 391	1 160 029 019
Catheter-associated urinary tract infections	27 884 193	18 765 813	37 002 574
Ventilator-associated pneumonia	3 094 270 016	2 796 898 212	3 408 445 101
Clostridium difficile infections	1 508 347 070	1 218 707 008	1 814 293 587
Total	**9 779 171 077**	**8 282 405 811**	**11 492 191 220**

JAMA Intern Med. 2013;173(22):2039-2046.
doi:10.1001/jamainternmed.2013.9763

But it gets worse

- Foreign Body Associated infections have been widely known for decades.
- These infections are at implant sites, but are amplified by the implant surfaces
- Bacteria tend to be attracted to the foreign body



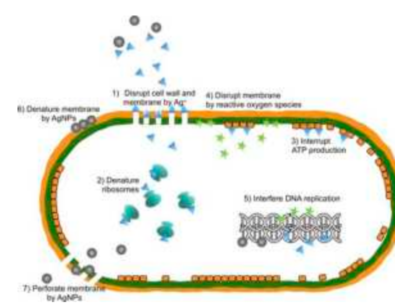
Urinary Stents https://doi.org/10.1007/978-3-031-04484-7

Background – Silver

- Silver has been known for its healing and preservation capabilities since ancient Greece.
- Numerous modes of delivery have shown silver to be effective in killing *Acinetobacter baumannii, Staphylococcus Aureus, Escherichia coli, Klebisella pneumonia*[5]
- Nanoparticle Silver is one effective phase to deliver silver to desired locations and has been used in colloid solutions for human consumption and embedded as part of bandages. Constrained since the release of ions is slow, uncontrolled, and difficult to place in localized deep infection regions.
- Pure Silver films have had disappointing performance as bactericidal coatings due to their slow ion release and poor adhesion properties.

Silver – still unsettled mechanism

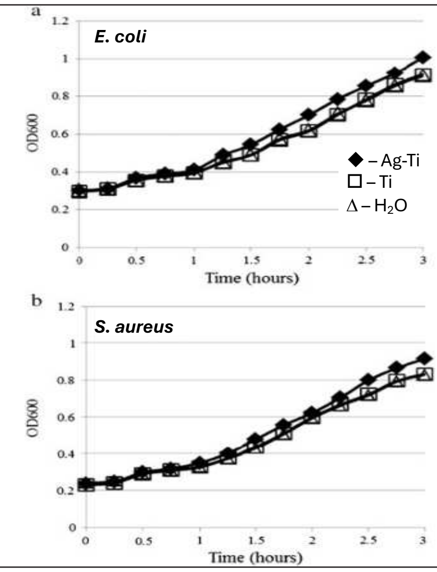
- The mechanism of action is still poorly understood
- Likely players include reaction with cysteine thiols in direct bond formation and catalyzing formation of disulfides
- Some indications of Ag-DNA interactions
- Other data indicates that Ag can may disrupt transport across bilayers and/or the ion gradient necessary for bacterial ATP production



https://www.tandfonline.com/doi/full/10.2147/IJN.S246764

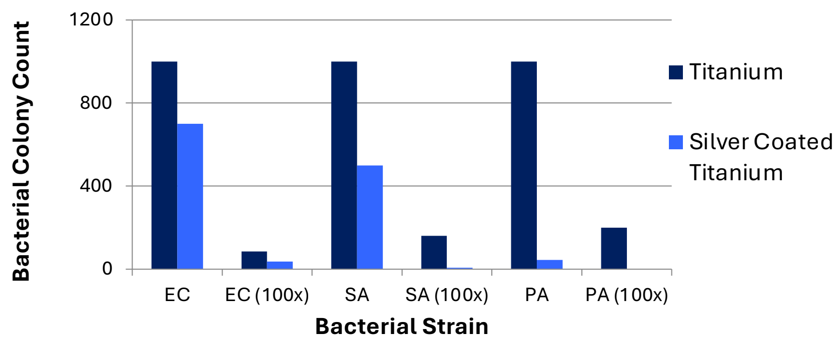
Pure Ag coatings

- Poor solubility
- Good contact killing / bacterial adhesion resistance



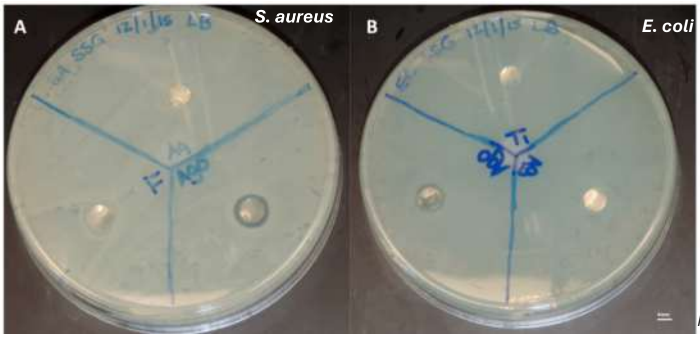
Surface and Coatings Technology, **2014**, 253, 52-57

Pure Ag Coatings



AgO/Ag_2O coatings

- Enhanced Solubility
- Enables killing WITHOUT requiring direct contact with the surface



Molecules **2017**, 22, 1487.

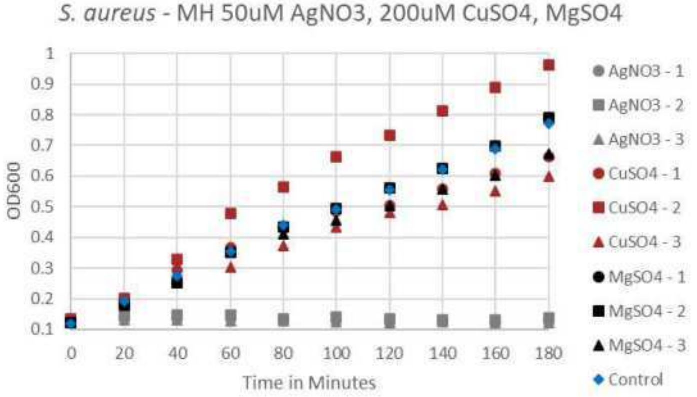
Results – Antibacterial Activity of AgO films

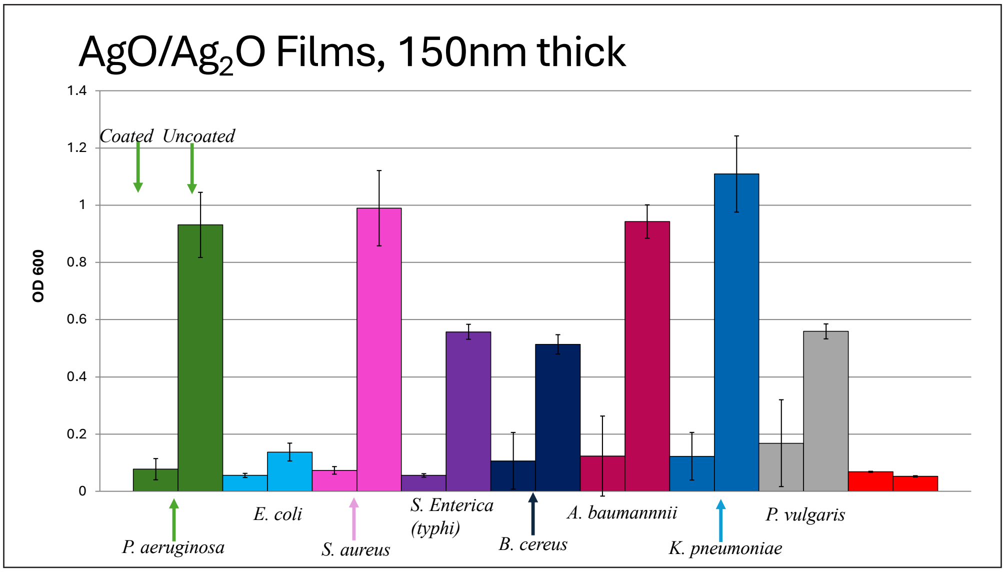
- Analyzed film composition and deposition effects on bacterial inhibition
  - Chemical composition of the coating
  - Method of deposition
  - Activity against various bacteria
  - Role of media on antimicrobial activity

Silver is **metal** as an antibacterial

- Silver is one of many heavy metals that show some antibacterial activity
- However, in many applications and settings, silver outperforms other metals as an antimicrobial

In solution silver is at least 4x more effective

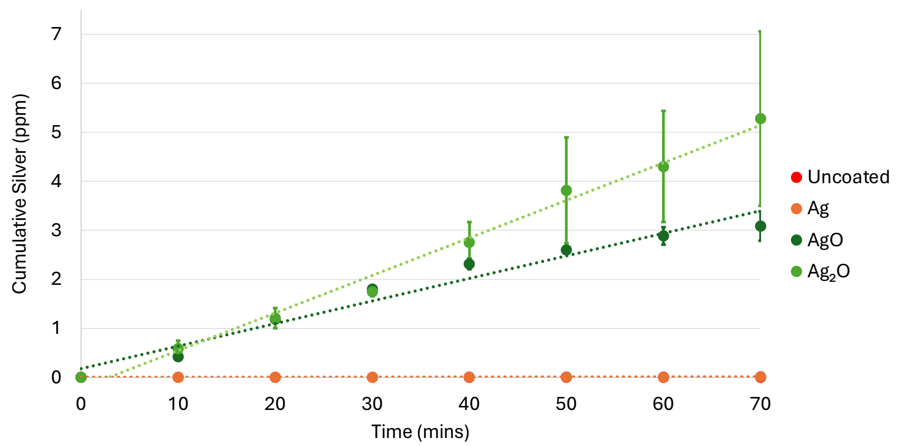



AgO/Ag2O Films, 150nm thick
OD 600
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Coated
Uncoated
P. aeruginosa
E. coli
S. aureus
S. Enterica (typhi)
B. cereus
A. baumannnii
K. pneumoniae
P. vulgaris

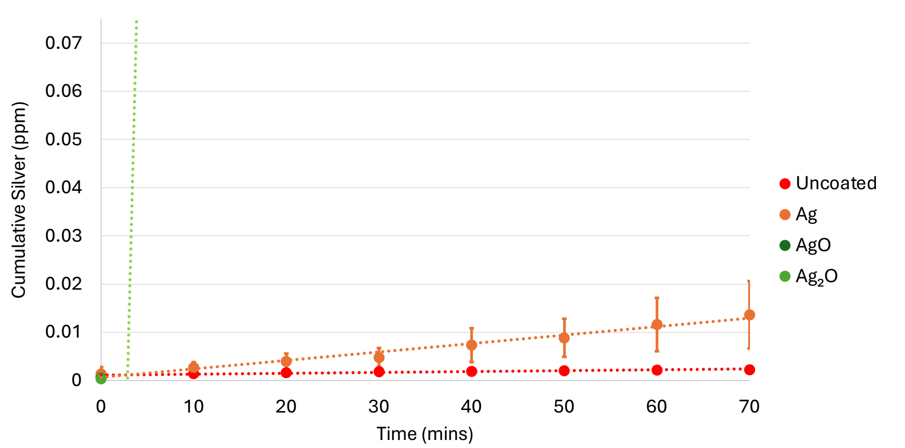
Results – Elution Rates

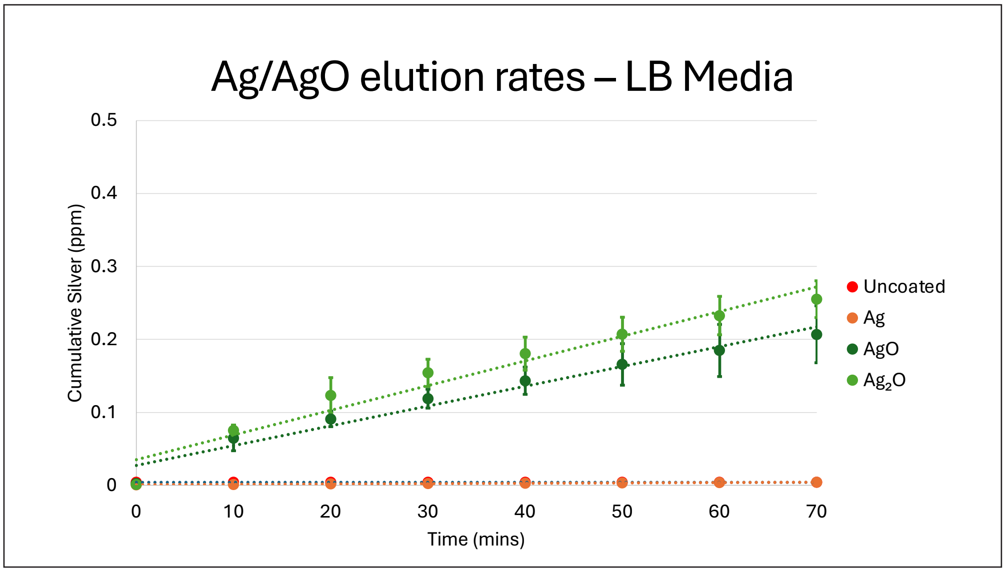
- Measured release of silver ions into solution using ICP-MS
- Measured solution Ag-ions from pure Ag, AgO, and Ag_2O films
- Measured environmental effects on release (media)

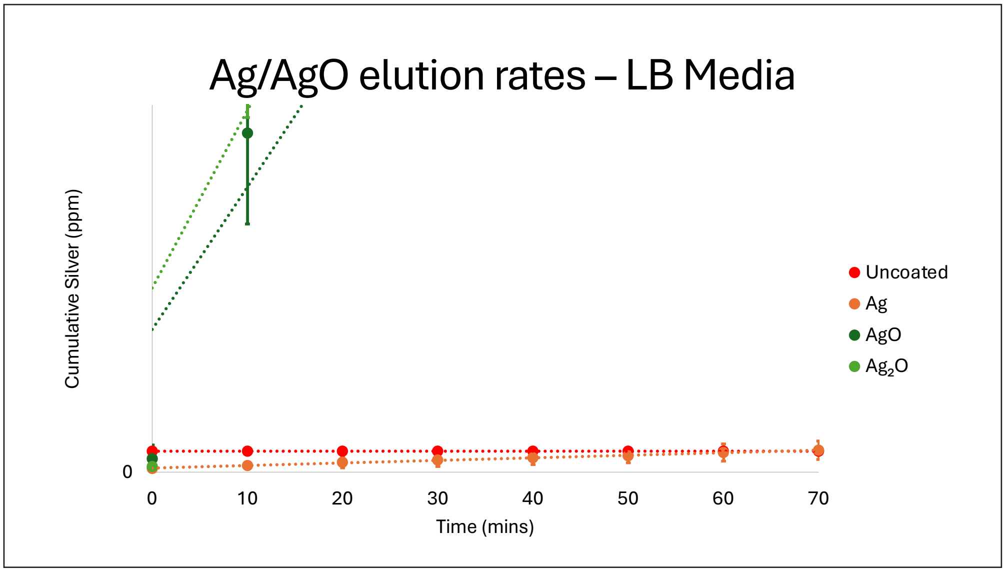
Ag/AgO elution rates - Water

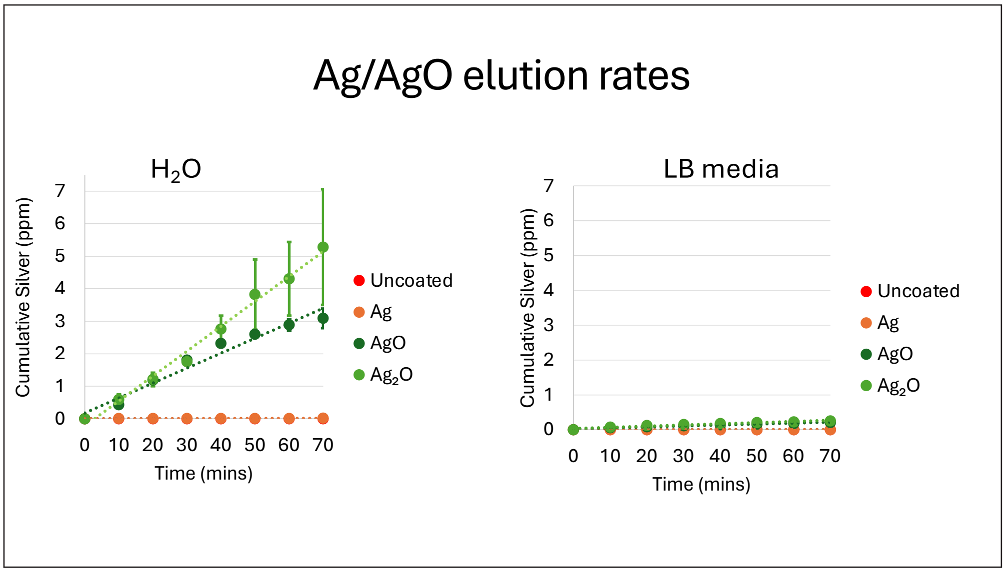


Ag/AgO elution rates - Water

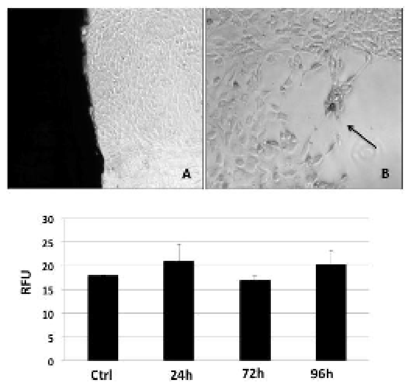



Ag/AgO elution rates – LB Media
Cumulative Silver (ppm)
0.5
0.4
0.3
0.2
0.1
0
0 10 20 30 40 50 60 70
Time (mins)
Uncoated
Ag
AgO
Ag2O


Ag/AgO elution rates – LB Media
Cumulative Silver (ppm)
0
0 10 20 30 40 50 60 70
Time (mins)
Uncoated
Ag
AgO
Ag2O

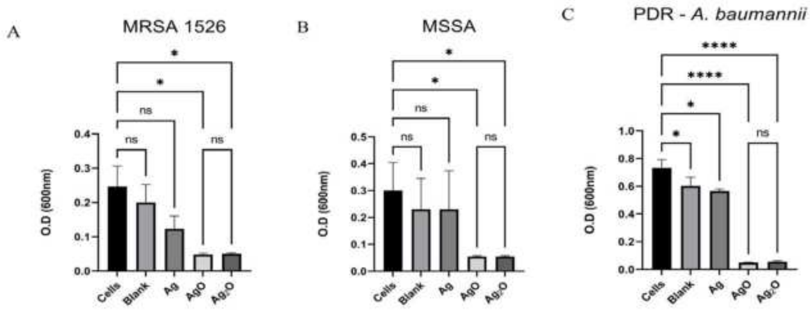

Ag/AgO elution rates
H2O
Cumulative Silver (ppm)
7 6 5 4 3 2 1 0
0 10 20 30 40 50 60 70
Time (mins)
Uncoated
Ag
AgO
Ag2O
LB media
Cumulative Silver (ppm)
7 6 5 4 3 2 1 0
0 10 20 30 40 50 60 70
Time (mins)
Uncoated
Ag
AgO
Ag2O

NIH3T3 Toxicity Study



A) Phase microscopy of cells and disk (darkened area) after **96h** of culturing.
B) Phase microscopy of cells growing into an open area around the silver-coated disk.

Pushing beyond lab strains

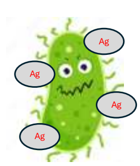


Results – Bacterial Growth Curves

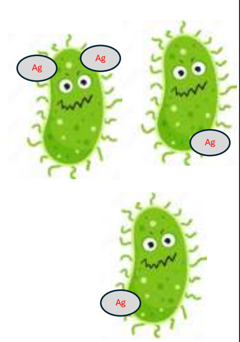
- Monitored effects on actively growing cultures of bacteria
- Relationship between bacterial cell density and efficacy
- Relationship between surface area and efficacy
- Relationship between film THICKNESS and efficacy

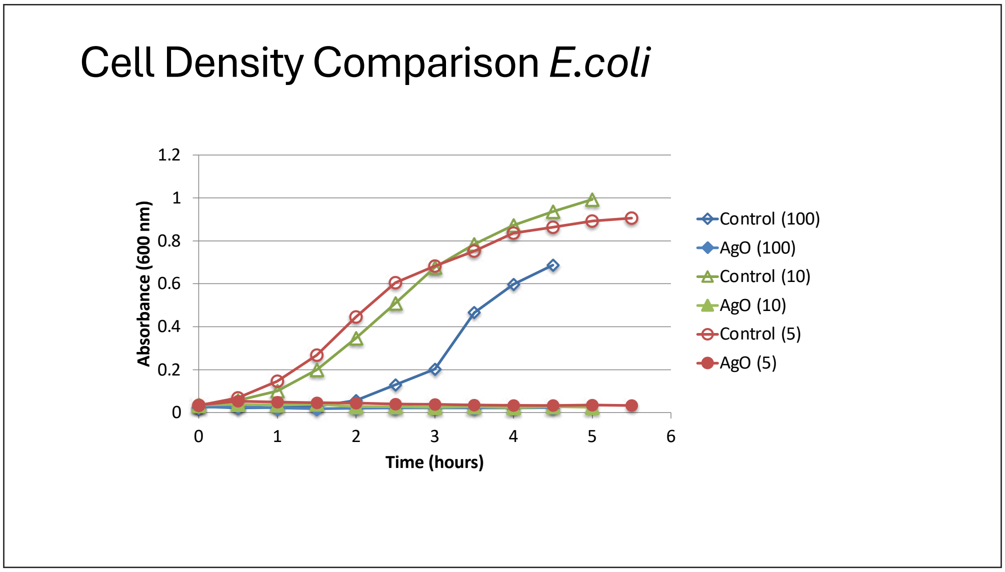
Cell Density Comparison

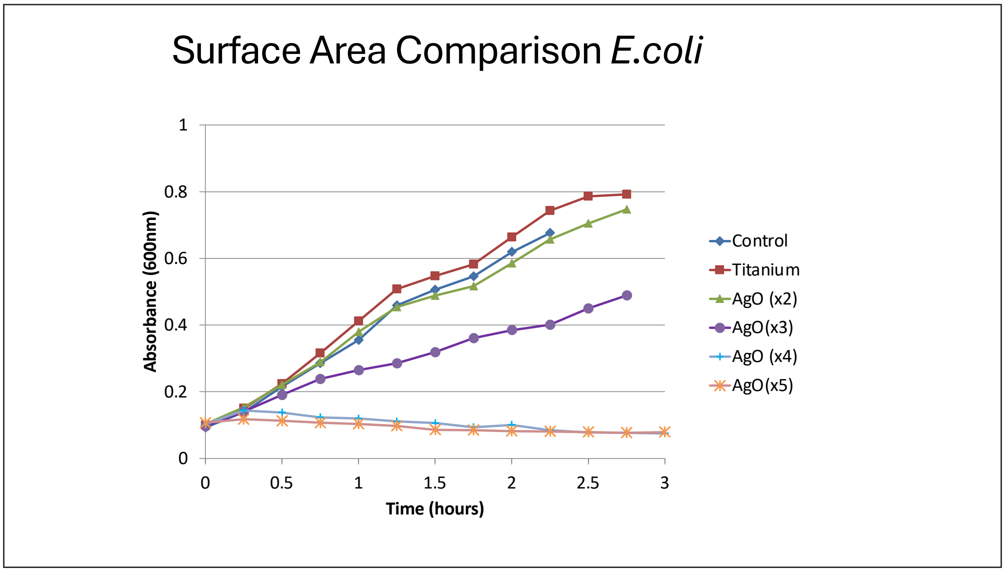
- Does the starting number of bacteria influence efficacy?
- Assuming fixed release rate from the surface, there are more (or less) active ions per bacterium

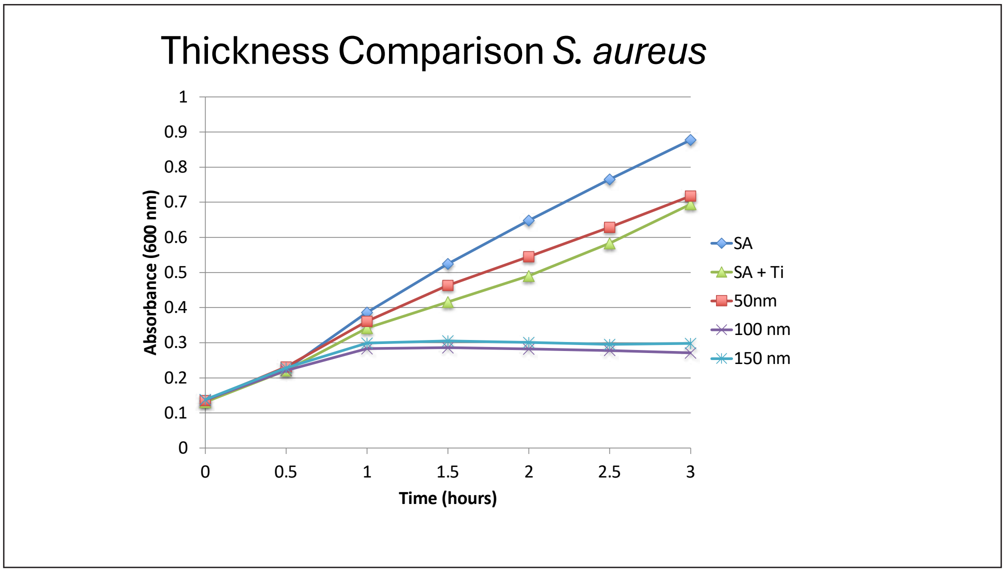


Vs.




Cell Density Comparison E.coli
Absorbance (600 nm)
Time (hours)
Control (100)
AgO (100)
Control (10)
AgO (10)
Control (5)
AgO (5)


Surface Area Comparison E.coli
Absorbance (600nm)
Time (hours)
Control
Titanium
AgO (x2)
AgO(x3)
AgO (x4)
AgO(x5)

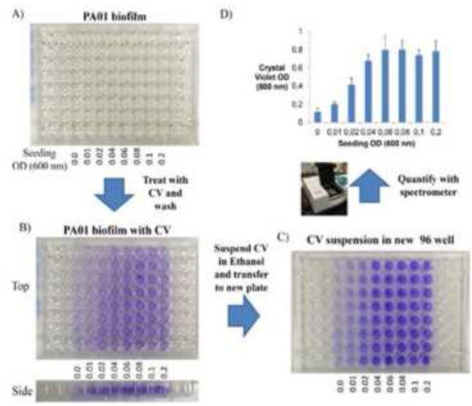

Thickness Comparison S. aureus
Absorbance (600 nm)
Time (hours)
SA
SA + Ti
50nm
100 nm
150 nm

CONTRIBUTED PRESENTATION IN POWERPOINT FORMAT FROM THE 2024 TECHCON

A HITCHHIKER'S GUIDE TO ANTIMICROBIAL THIN FILM COATINGS

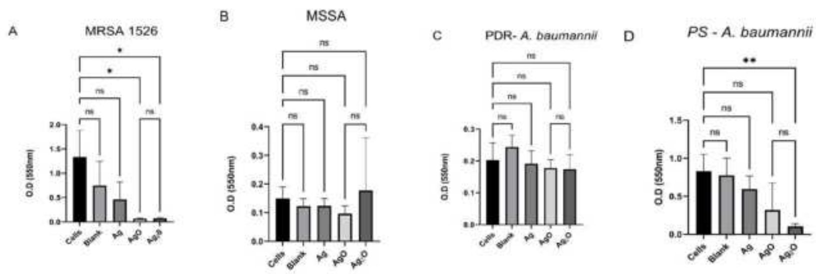
Biofilm assays

- Bacteria in biofilms will remain in tubes/wells after simple pipetting and rinsing
- Relies on the uptake of the dye crystal violet into the bacterial cell
- Then the dye is liberated by organic solvent or acids and quantified



Res Rev J Eng Technol. 2017 Dec; 6(4):

Biofilm Assay



Quick recap

- Release kinetics are impacted by the release media
  - Water > bacterial growth media
- $\uparrow$surface area $\uparrow$efficacy
- $\uparrow$bacterial starting density ? Efficacy
  - So far, we're out-pacing them!
- $\uparrow$coating thickness $\uparrow$efficacy
- AgO and Ag2O films can inhibit biofilm formation in clinically relevant bacteria, but more variable than planktonic assays

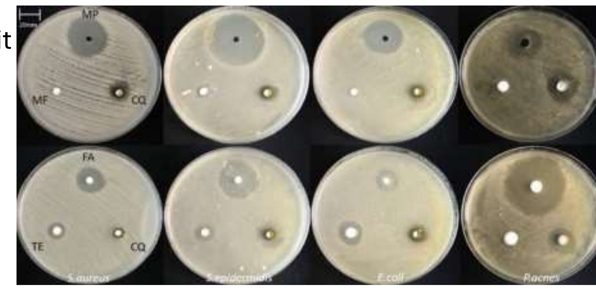
Environment plays a key role in antibacterial efficacy of metals

- Can affect the release rates
- But is this purely a concentration effect?

- Noticed a difference in efficacy between solid and liquid phase behavior.
- Investigated using Kirby-Bauer Zone Of Inhibition (ZOI) tests

ZOI

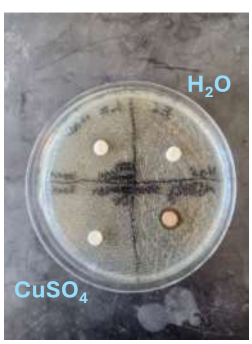
- Filter disc with antibiotics loaded into it placed on a petri dish pre-seeded with bacteria of interest
- ↑size of zone of inhibition ↑efficacy



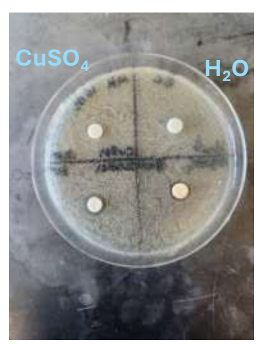
You, Z. & Ran, X. & Dai, Y. & Ran, Y.. (2018). Clioquinol, an alternative antimicrobial agent against common pathogenic microbe. Journal de Mycologie Médicale. 28. 10.1016/j.mycmed.2018.03.007.

Media matters

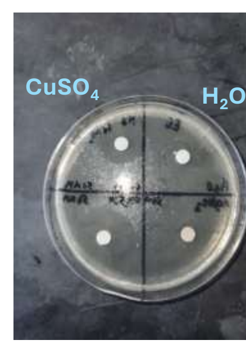
Luria Bertani



Mueller Hinton

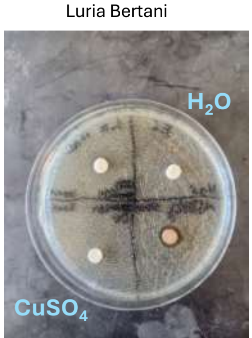


Nutrient Broth

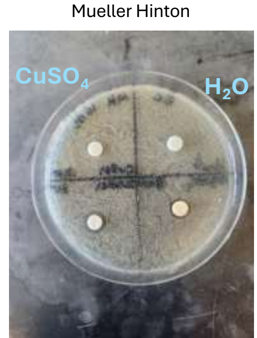


Media matters

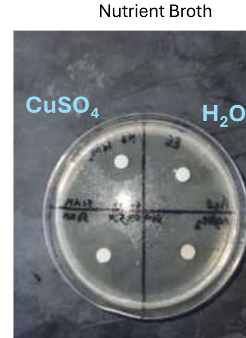
Luria Bertani



Mueller Hinton

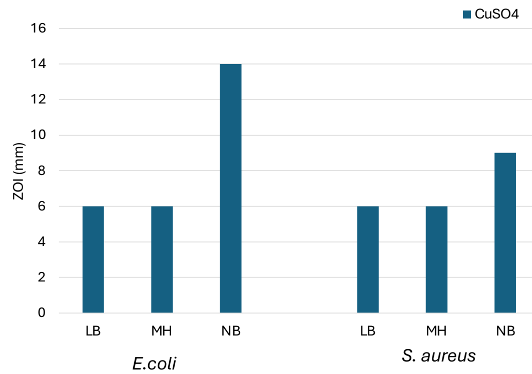


Nutrient Broth

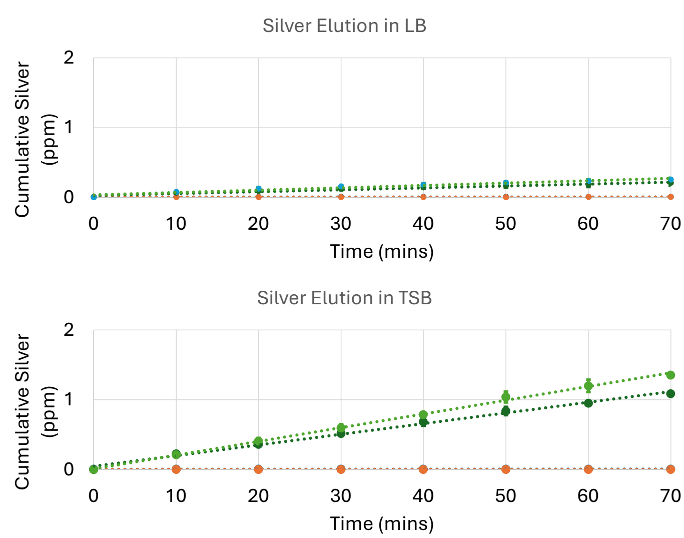



Media matters
Luria Bertani
Mueller Hinton
Nutrient Broth
CuSO4

Media Matters

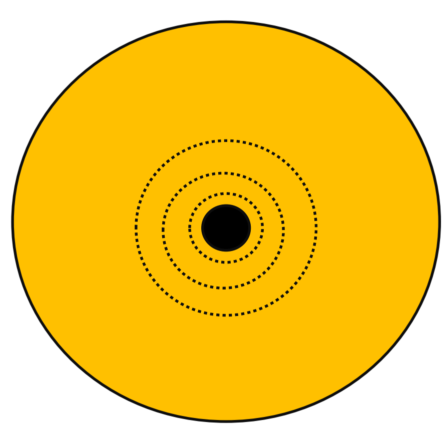


Back to ICP



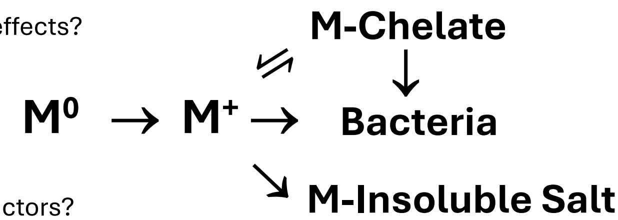
Ongoing experiments

- Lots of ICP and growth curves – how much of this effect is limited to solid plates vs planktonic growth?
- Do we see the same trends in biofilms regarding media sensitivity?
- Can we assess the diffusion of metals in solid media?
  - The bullseye assay



Why does the growth media matter?

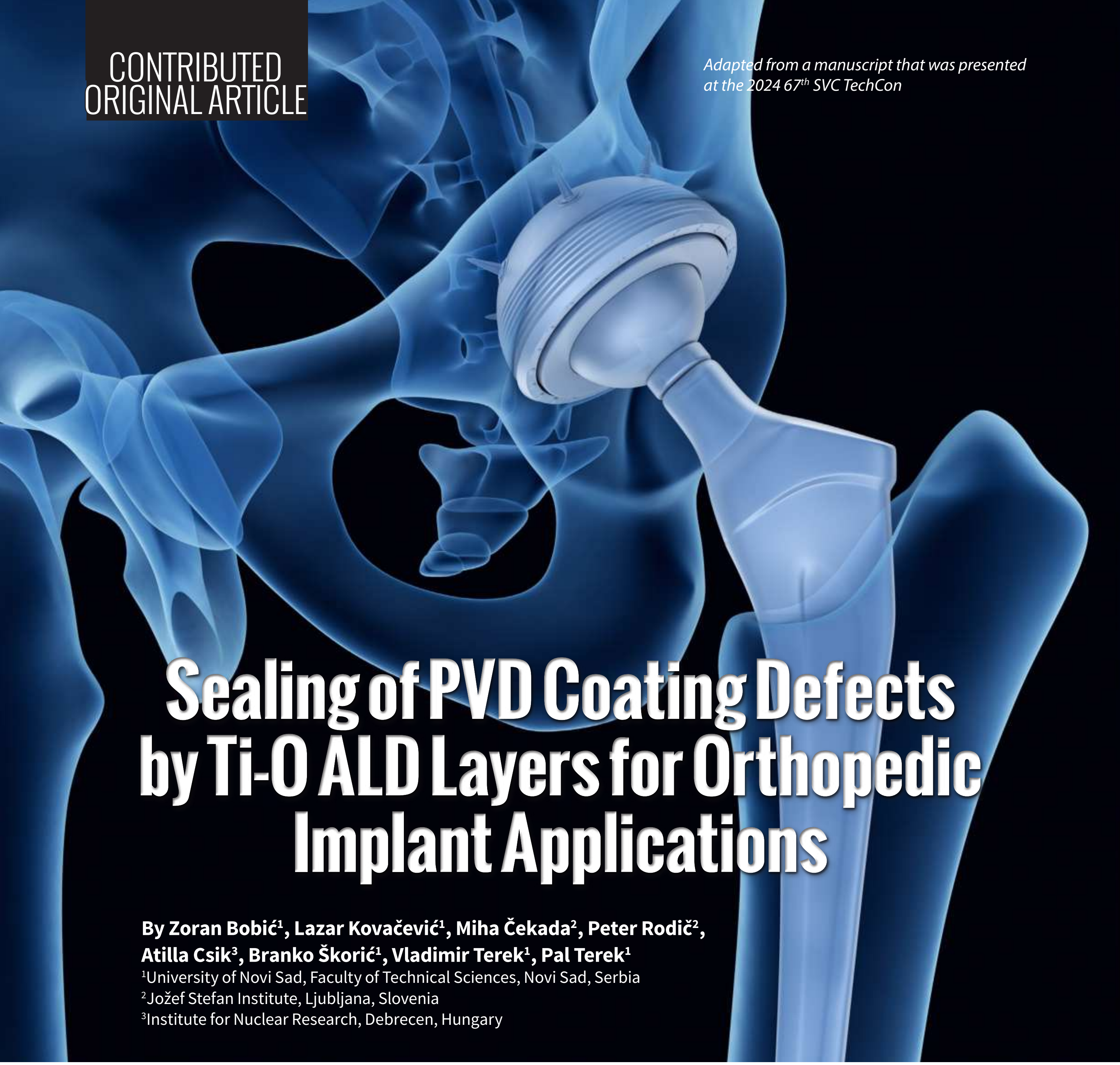
- Clearly, we are still inhibiting bacteria
- Diffusion-limiting factors?
  - Porosity differences?
  - Hydration differences?
- Chelation effects?



- Bacterial factors?

Why does it really matter?

- Fundamentally, model systems should be good models
- Biomedical device innovations often under-deliver and some of that is from poor translation
- Better predictions can enhance activity and reduce deleterious side effects



CONTRIBUTED ORIGINAL ARTICLE

Adapted from a manuscript that was presented at the 2024 67th SVC TechCon

Sealing of PVD Coating Defects by Ti-O ALD Layers for Orthopedic Implant Applications

By Zoran Bobić[1], Lazar Kovačević[1], Miha Čekada[2], Peter Rodič[2], Atilla Csik[3], Branko Škorić[1], Vladimir Terek[1], Pal Terek[1]

[1]University of Novi Sad, Faculty of Technical Sciences, Novi Sad, Serbia
[2]Jožef Stefan Institute, Ljubljana, Slovenia
[3]Institute for Nuclear Research, Debrecen, Hungary

With a goal to assess the efficiency of physical vapor deposi-tion (PVD) coating defect sealing by atomic layer deposition (ALD) layers, we investigated the corrosion resistance of PVD TiN and TiN + ALD Ti-O (amorphous and anatase) layers in Hank's solution. The corrosion experiments were conducted on circular areas with 2 mm radius, employing electrochemical impedance spectroscopy (EIS) and potentiodynamic polariza-tion (PD) measurements. To identify defect types, quantities, and their dimensions, confocal and tactile profilometry were performed before and after the corrosion tests. Results revealed that corrosion resistance of layers is influenced by the quantity of through-thickness "critical" defects.

The above-coating height of these defects is approximately half of the coating thickness, and their diameter is proportional to the coating's thickness. With an increase in their quantity the corrosion resistance of a coated system decreases. Scanning electron microscopy (SEM) of the focused ion beam (FIB) milled cross-sections revealed a uniform surface coverage by both ALD layers and effective defect sealing. Therefore, application of ALD layer over the PVD coatings emerges as a highly effective strategy for enhancing their corrosion resistance. Additionally, SEM and atomic force microscopy (AFM) anal-ysis of a hybrid layer with anatase TiO2 revealed formation of protruding nano-features on the surfaces. Such features have promising effects on the bone-cells activity and increased implant osseointegration.

INTRODUCTION

PVD is a widely used technique for applying thin ceramic coatings that enhance the surface properties of materials, i.e. the corrosion resistance. However, the deposition process is accompanied by the formation of growth defects [1,2], which can significantly impact the corrosion behavior of the coated system [3–5]. In previous studies opposing trends about the effect of density of the growth defects on corrosion protection are reported [3–8]. This can be attributed to the fact that previous investigations did not consider the joint influence of the defect size and their density on corrosion properties.

The deposition of a uniform ALD layer over PVD coatings was demonstrated to have significant potential as a method to overcome the influence of PVD growth defects on corrosion protection [9,10]. The ALD is particularly valued for its ability to create highly uniform layers [9,10] that can effectively seal the pinhole type of defects within the PVD coatings [11,12]. However, the effectiveness of the ALD in sealing the pinholes around protrusions type of defects (i.e. nodular defects) was not thoroughly explored.

In this study, the corrosion properties of PVD TiN coatings, with different density of growth defects, and TiN coating with Ti-O ALD overlayer was evaluated. The first goal was to determine the dependance between the defect size and corrosion properties of TiN coatings. The second goal was to evaluate the effect of growth defects on the sealing with ALD layers deposited on TiN coatings

EXPERIMENTAL METHODS

TiN coatings were deposited on polished EN X2CrNiMo17-12-2 (1.4404) substrates in multiple batches using an industrial electron beam evaporation unit BAI 730 (Balzers) and a laboratory reactive sputtering unit Sputron (Balzers) to obtain coatings with varying densities of PVD growth defects

The ALD technique was used to deposit thin films of amorphous TiO_2, anatase TiO_2, and a double layer of anatase/ amorphous TiO_2 onto substrates previously coated with PVD. For the dual layer deposition, anatase was deposited first, followed by the amorphous layer. Both the amorphous and anatase layers, each with a thickness of 50 nm, were deposited using a TFS 200 (Beneq). The depositions were conducted in thermal mode, with the amorphous layer deposited at 80 °C and the anatase layer at 200 °C. The reactor pressure was maintained at 1.4 mbar, while the chamber pressure was kept at 6.8 mbar during the process. The ALD cycle involved 300 ms of $TiCl_4$ exposure, which is followed by a 3-second purge, a 300 ms of water vapor exposure, and another 3-second purge. In Table 1 a sample designation is given.

The surface topography characterization was performed with 3D optical (Axio CSM700, Zeiss, Germany) and tactile (Dektak XT device from Bruker) profilometer. 3D tactile measurements were performed over the area of 2x1 mm, with lateral resolutions of 0.3 µm in the X direction and 2 µm in the Y direction. The changes in nanotopography caused by the deposition of ALD layers were studied on predefined locations using atomic force microscopy (AFM) CPII-di (Veeco). AFM measurements were conducted over the areas of 3x3 µm in contact mode using the following parameters: a resolution of 256 × 256 pixels, setpoint of 225 nN, and a scan rate of 0.5 Hz. Surface analysis, calculation of surface roughness parameters, and PVD growth defect analysis were conducted using SPIP 6.2.0 (Image Metrology) image analysis software.

A dual-beam FIB-SEM microscope Scientific Scios 2 (Thermo Fisher), equipped with an energy dispersive spectroscopy (EDS) analyzer r, was utilized to examine the thickness, uniformity, and sealing effectiveness of the ALD layers.

Table 1 – Sample designation.

PVD deposition	**ALD deposition**		
	Amorphus Ti-O	Anatase Ti-O	Anatase and amorphous Ti-O
TiN (Industrial)	TiN_I-AM	TiN_I -AN	TiN_I-AN+AM
TiN (Labaratory)	TiN_L-AM	TiN_L-AN	TiN_L-AN+AM

Corrosion performance was evaluated using EIS and PD techniques. The measurements were performed one hour after the start of exposure, using a three-electrode cell, with 0.785 cm^2 of the sample exposed to Hank's solution. Corrosion measurements were performed on four different, non-overlapping areas on each sample. The reference electrode was silver/silver chloride (Ag/AgCl, 0.25 V vs. saturated hydrogen electrode), and a carbon rod was used as the counter electrode. Experiments were conducted at room temperature using a Multi Autolab PGSTAT M204 (Metrohm Autolab) potentiostat/galvanostat, controlled by Nova 2.1 software. Electrochemical impedance spectra were obtained over a frequency range of 10 mHz to 100 kHz using a Frequency Response Analyzer (FRA) module. After the EIS measurements, PD measurments were conducted within a potential range of 200 mV below to 1000 mV above the open circuit potential (OCP). The corrosion current (icorr) and corrosion potential (*Ecorr*) were determined from the Tafel plots.

RESULTS

The results of confocal profilometry measurements conducted on TiN_I and TiN_L are presented in Fig. 1. In comparison to the TiN_L the TiN_I has a greater number of dark spots, which correspond to PVD growth defects.

Results of the AFM measurements before and after the deposition of ALD on TiN_L coatings are displayed in Fig. 2. Addition-

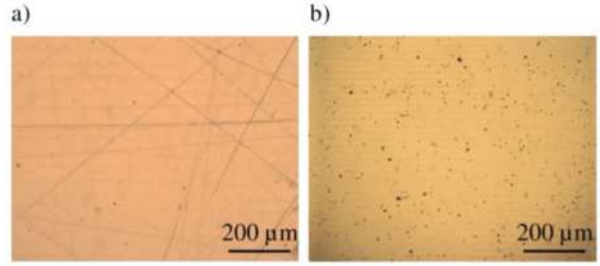


Fig. 1 – Confocal representative images for **a**) TiN_L coating and **b**) TiN_I coating.

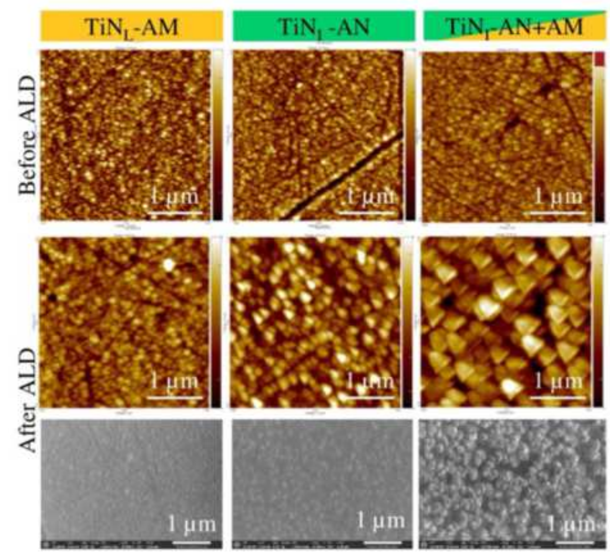


Fig. 2 – AFM images before and after deposition with SEM images after deposition of examined layers on TiN_I coating.

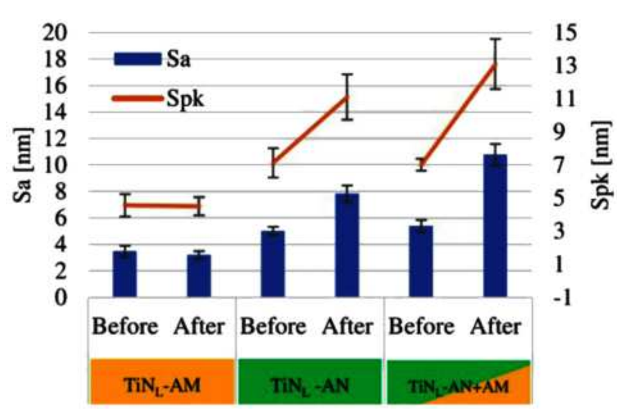


Fig. 3 – Surface roughness parameters Sa and Spk before and after deposition of ALD layers.

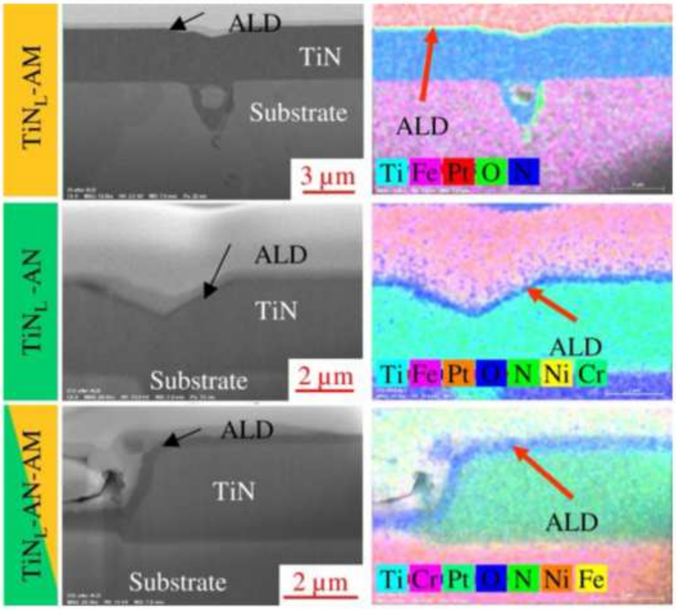


Fig. 4 – FIB-SEM images of ALD layers cross sections.

ally, in this figure the SEM images of surfaces after the ALD are also shown. The deposition of an amorphous TiO_2 layer did not result in a significant change in surface topography. Deposition of anatase TiO_2 led to the formation of needle-like or grain-like features on the surface, with relatively smooth areas between these features. In the dual ALD layer, group (TiN_L-AN+AM), the surface is completely covered with grain-like or needle-like features.

The deposition of amorphous TiO_2(TiN_L-AM) did not significantly affect the surface roughness parameters Sa and Spk(Fig.

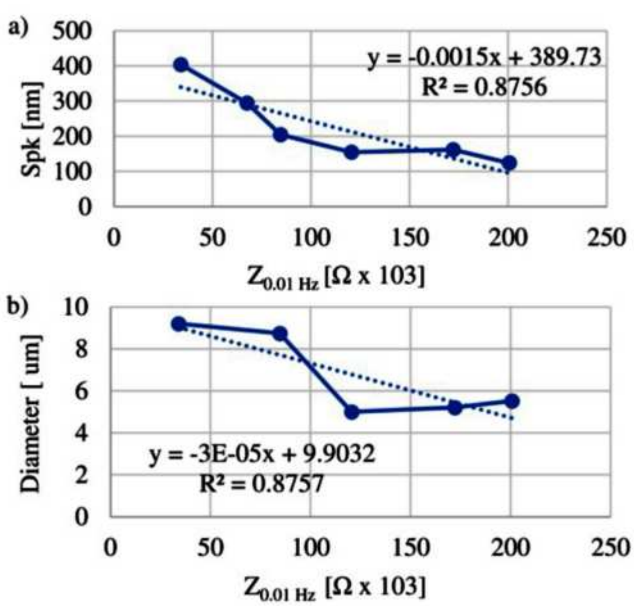


Fig. 5 – Correlation analysis between Z0.01Hz and: **a**) Spk roughness parameter and **b**) maximal nodular PVD diameter.

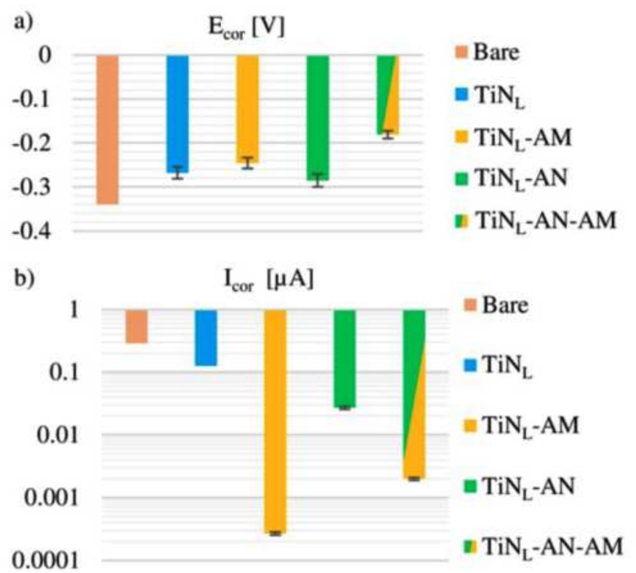


Fig. 6 – PD results on group with PVD TiN_L coating: **a**) corrosion potential and **b**) corrosion current.

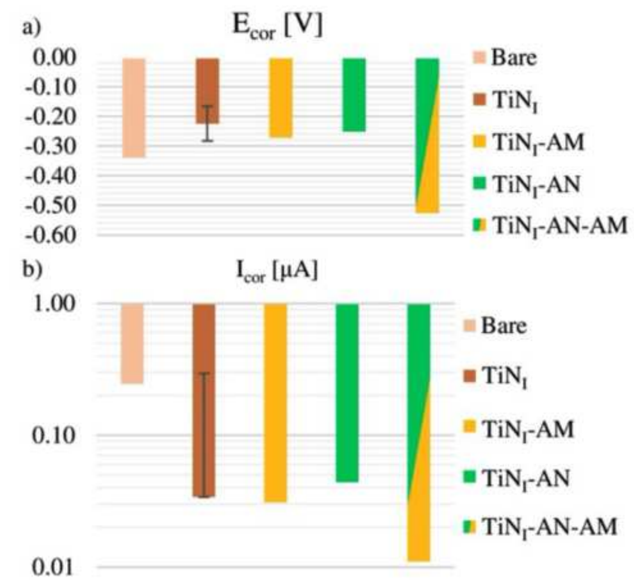


Fig. 7 – PD results on group with PVD TiN_I coating: **a**) corrosion potential and **b**) corrosion current.

3), unlike the anatase(TiN_L-AN) and dual ALD (TiN_L-AN-AM) TiO_2 layers. However, for TiN_L-AN-AM the changes in these parameters are the most pronounced.

Representative SEM images of FIB cross-sections for each ALD layer deposited on TiN_L are shown in Fig. 4. The results demonstrate that the examined ALD layers uniformly cover the surface and no visible defects or cracks near PVD growth defect can be seen.

The correlation analysis between impedance at 0.01 Hz and the surface roughness parameter Spk, as well as between the impedance and the nodular defects diameter, is presented in Figures 5a and 5b. An increase in the Spk parameter, which describes the volume of peaks on the observed surface, is associated with a decrease in the impedance. Similarly, an increase in the diameter of the largest nodular defects also leads to a decrease in the impedance. Additionally, there is no significant correlation between the number of nodular defects and impedance.

Figures 6a and 6b display the results of the PD corrosion tests for the TiN_L coating and ALD layers deposited on TiN_L. Compared to TiN_L, the corrosion potential did not change significantly after the ALD deposition. However, there is a pronounced decrease in the corrosion current. The most significant reduction in corrosion current is observed for the TiN_L-AM. Furthermore, the deposition of an amorphous ALD layer on a previously deposited anatase layer (TiN_L-AM-AN) additionally decreased the corrosion current, compared to the TiN_L-AN. However, the corrosion current in the TiN_L-AM-AN remained an order of magnitude lower than that observed for the TiN_L-AM.

Figures 7a and 7b display the results of the PD corrosion tests for the TiN_I coating and ALD layers deposited on TiN_I. The deposition of the TiN_I coating improved the corrosion properties compared to the bare substrate. However, the deposition of either amorphous (TiN_I-AM) or anatase (TiN_I-AN) TiO_2 layers did not provide a notable enhancement in corrosion potential and current. In contrast, dual layer (TiN_I-AN-AM) configuration induced a pronounced improvement in corrosion current.

Figures 8a and 8b present the results of PD corrosion tests conducted on different locations of TiN_I-AM and TiN_I-AN-AM

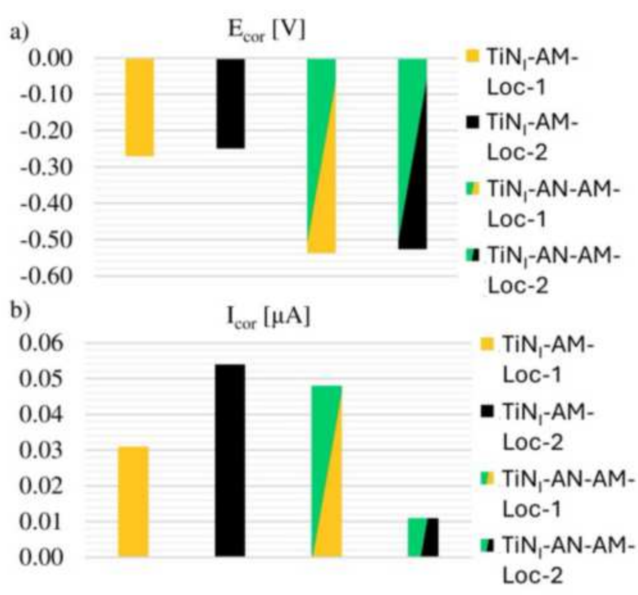


Fig. 8 – PD results performed on one sample for group TiN_I-AM and TiN_I-AN-AM: **a**) Corrosion potential and **b**) Corrosion current

samples. The results revealed a relatively high variation in the corrosion current on the testing location.

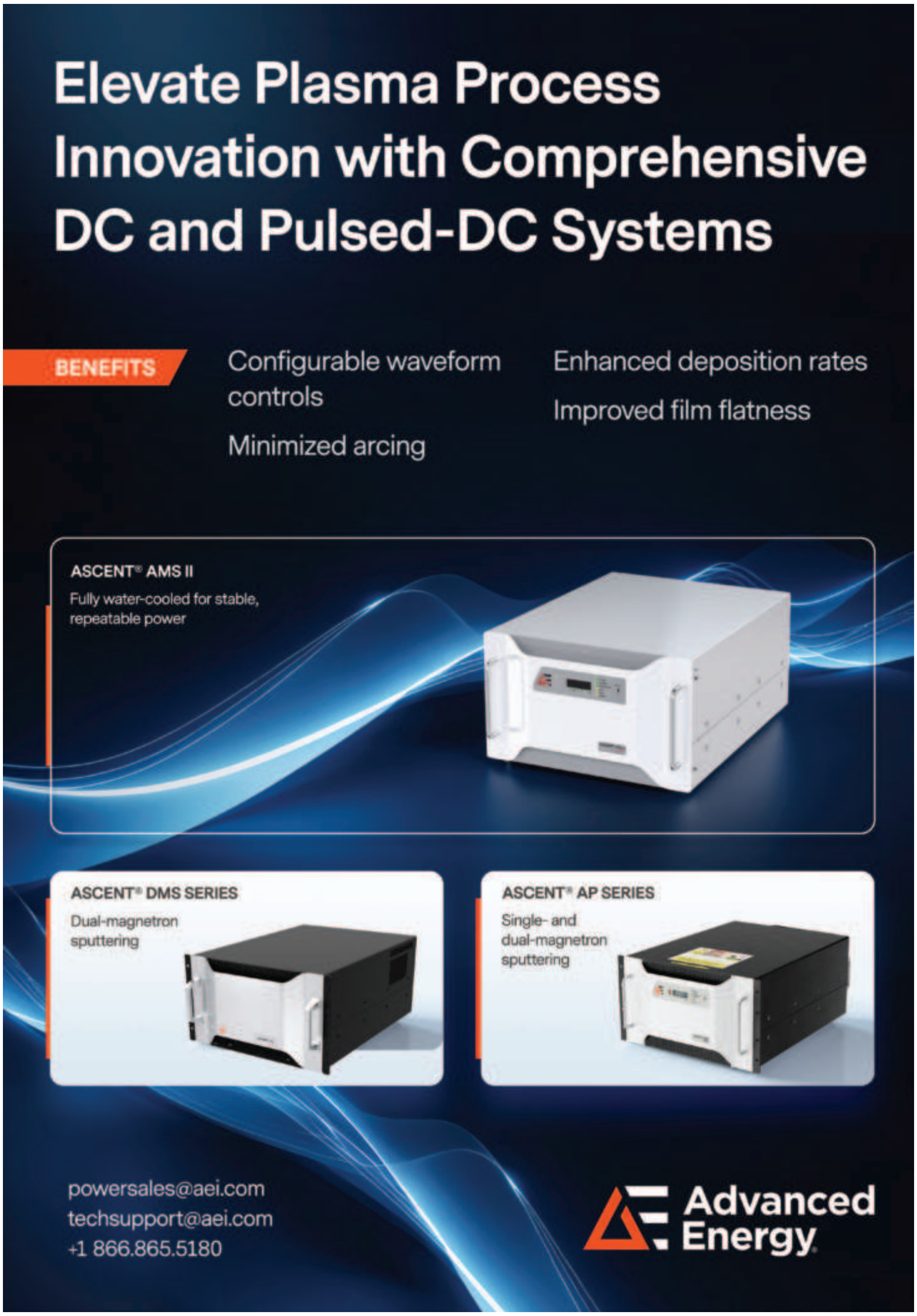
DISCUSSION

Previous investigations suggested that an increase in the overall density of defects did not necessarily decrease corrosion resistance [3–5]. Studies [6–8] indicated that the size of defects could determine whether a PVD defect would act as an active site for corrosion process. In other words, researchers in [2–4,13–16] suggested that larger defects and an increase in their density could lead to a more pronounced reduction in corrosion properties.

In this study, samples with TiN coatings deposited in a laboratory unit had a significantly lower density of PVD growth defects than those deposited in an industrial unit (Fig. 1). Since the substrates were prepared using the same procedure, the probability of defect formation due to geometric factors related to surface topography features [8] was similar in both deposition units. The difference in defect density could be caused by a higher presence of impurities in the industrial chamber during the deposition process [8]. Even though the density of defects is greater for the TiN_I than the TiN_L coating, the corrosion properties are better for TiN_I. This difference is likely to occur due to differences in coating microstructure that could have also affected the corrosion resistance [17]. Correlation analysis revealed that the overall density of PVD defects does not correlate well with changes in the impedance, which is in line with findings from previous investigations [3–5]. Instead, the Spk surface roughness parameter and the diameter of the largest nodular defect showed a strong correlation with changes in the impedance (Fig. 5a and 5b). These findings confirm previous suggestions that the size of defects, rather than the overall density of defects, has a greater influence on corrosion properties [6–8]. However, more comprehensive investigations are needed to confirm these results.

The capability of ALD deposition to produce nearly defect-free, uniform thin films has been well-documented [18–23]. In works [10–12,24–30] the application of thin ALD layers on previously deposited PVD coatings has been extensively examined and it was demonstrated that the deposition of ALD layers significantly improves corrosion properties. This improvement was primarily attributed to the ability of the uniform thin ALD layer to seal pinholes in PVD coatings [12].

The deposition of the examined ALD layers on TiN_L resulted in the formation of a uniform layer (Fig. 4) and led to enhanced corrosion resistance (Fig. 6). This result is consistent with the previous findings [10–12,24–30]. The deposition of anatase layers changed the surface topography due to the formation of

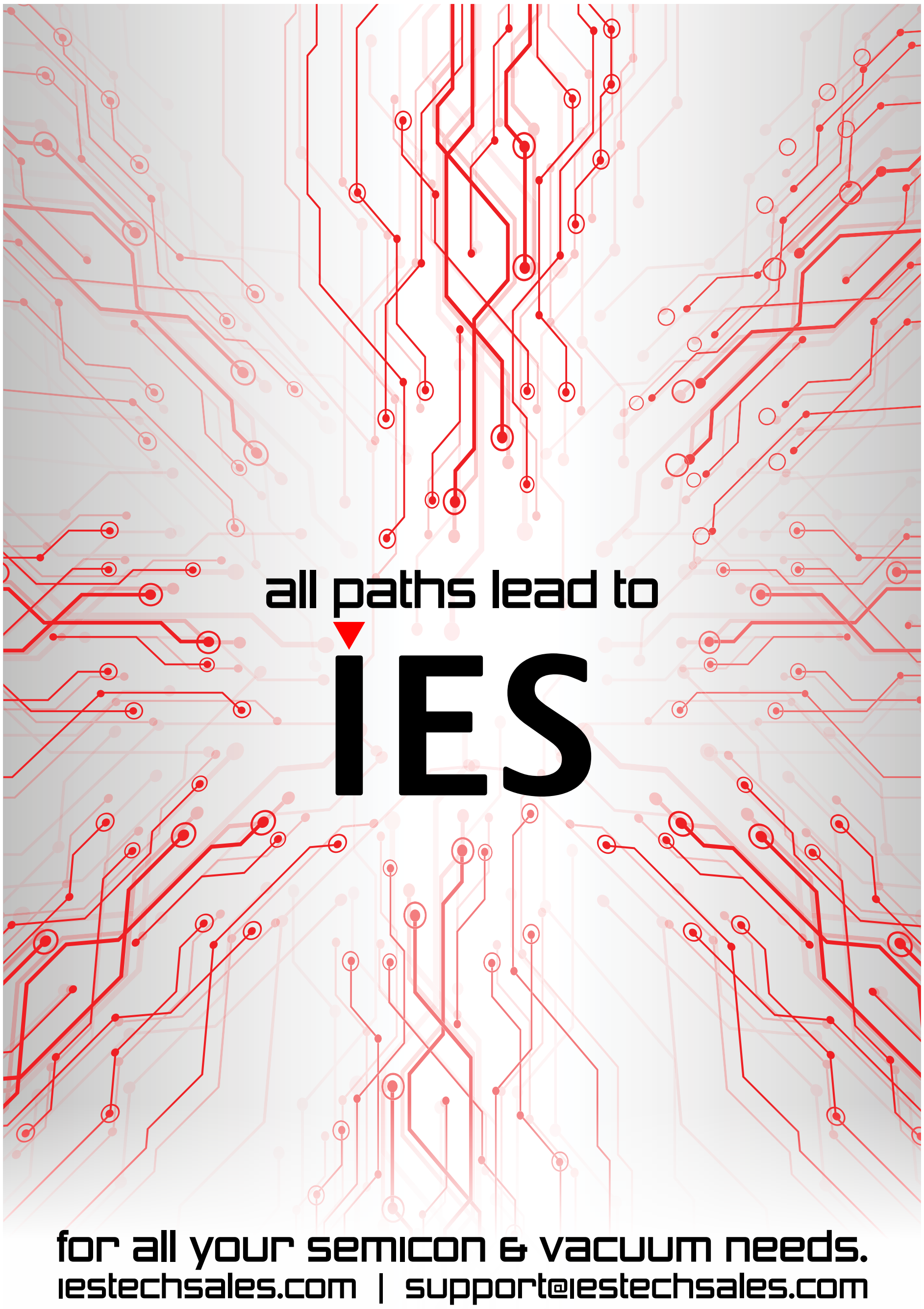


SEALING OF PVD COATING DEFECTS BY TI-O ALD LAYERS FOR ORTHOPEDIC IMPLANT APPLICATIONS

TiO_2 crystals, whereas the deposition of the amorphous layer did not cause any changes in it. The presence of these crystals, combined with slightly higher deposition temperatures, could have introduced higher residual stress in the ALD layer of TiN_L-AN group [31]. Consequently, this reduced its effectiveness in sealing the PVD defects in comparisons to amorphous TiO_2 layer of TiN_L-AM group. In the case of the TiN_L-AN-AM group, larger crystals uniformly cover the surface without a visible amorphous matrix around the anatase grains (Fig. 2). This suggests that the ALD deposition parameters used for deposition of the amorphous layer over the previously deposited anatase layer promoted further formation or growth of anatase grains, resulting in an increase in surface roughness (Fig. 2 and 3) and crystallinity. Increased crystallinity [32] and thickness [12] of ALD layer potentially lead to increased corrosion resistance compared with the anatase ALD layer alone.

The deposition of the ALD layer over the TiN_I coating produced in an industrial unit did not significantly improve the corrosion properties (Fig. 7). The most notable improvement is observed for TiN_I-AN-AM group, which could be caused by increased thickness of the ALD layer.

Based on the results (Figs. 6, 7, 8) from this investigation, it is suggested that the efficacy of defect sealing with ALD layers is influenced by density and the dimensional characteristics (i.e. diameter) of PVD growth defects. PVD defects are microlocations where the surface deviates significantly from an ideal flat surface, and it is characterized by abrupt local transitions in surface geometry. These areas are susceptible to stress concentration, which together with the layer residual stresses can lead to crack formation and fracture of the ALD layer. However, further investigation is needed to confirm this finding.



CONCLUSIONS

In this investigation, the corrosion protection of TiN PVD coatings, with and without different ALD Ti-O layers, was evaluated. The study aimed to determine the influence of PVD growth defects on the corrosion protection of these coatings. Additionally, the goal was to assess the effectiveness of the various ALD layers in sealing the PVD growth defects. Based on the presented results, the following conclusions can be drawn:

- The PVD TiN coating improves the corrosion resistance of the underlay substrate.
- While the overall density of PVD growth defects does not correlate with corrosion resistance, the diameter of the largest nodular PVD defect reveals a significant correlation with this property.
- The amorphous TiO_2 ALD layer demonstrates superior sealing effectiveness compared to the anatase TiO_2 layers. It can be postulated that this is due to the higher residual stress present in the anatase TiO_2 layer.
- This is because the defects are the sites with abrupt changes in surface geometry where the ALD layers can crack due to the high stress concentration. Further investigation need to confirm the previous.

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CONTRIBUTED PRESENTATION
IN POWERPOINT FORMAT
FROM THE 2024 TECHCON

Adapted from a Powerpoint Presentation that was presented at the 2024 67th TechCon

Antimicrobial Protection for Touch Surfaces to Reduce Hospital Associated Infections

By Lara Maroto-Diaz[1], Patricia Killen[1], Dermot Monaghan[1], Víctor Bellido-Gonzalez[1], Rick Spencer[2], Jason Eite[2], Ameen Belke[2], Gavin Ackers-Johnson[3], Adam P. Roberts[3], Danielle Mclaughlan[4], Amy Doyle[4], Stacy Todd[4]

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[2]Diamond Coatings, Dudley, United Kingdom

[3]Liverpool School of Tropical Medicine, Liverpool, United Kingdom;

[4]Liverpool University Hospital Foundation Trust, Liverpool, United Kingdom

CONTRIBUTED PRESENTATION IN POWERPOINT FORMAT FROM THE 2024 TECHCON

ANTIMICROBIAL PROTECTION FOR TOUCH SURFACES TO REDUCE HOSPITAL ASSOCIATED INFECTIONS

Touch surfaces play a crucial role in the transmission of bacteria and pathogens, especially in hospital and healthcare settings. There are many pathogens which are commonly found in patient wards and public areas throughout hospitals that lead to Hospital Associated Infections (HAI) which can have a devastating effect on the physical, mental, and financial health of a patient. In addition to this, HAIs cost the healthcare system billions of dollars a year in added expenditure. Furthermore, it has been found that a growing number of the pathogens detected have become resistant to the antimicrobial medications typically used to control them.

This work presents novel magnetron sputtered coatings have been developed with very high levels of biocidal efficacy. Sputtered antimicrobial surfaces have been produced in industrial PVD systems, including box coaters and Roll-to-Roll machines. 2D and 3D components were coated, as well as transparent flexible films. The surfaces have been deployed in the Royal Liverpool University Hospital in the United Kingdom. Flexible films were adhered to patient self-check in kiosks, and push pads and handles were installed throughout busy wards. This paper presents results from standard antimicrobial tests conducted over a 24-hour period, and long term data acquired during the regular monitoring of the surfaces.

Note from Managing Editor: We are delighted to share with the readers of the Bulletin some of the interesting Powerpoint Presentations from past TechCons. We hope you find them as interesting as we do.

Sue Taube/Managing Editor

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https://www.svc.org DOI: https://doi.org/10.14332/svc24.proc.0065

TechCon 2024 Chicago

Antimicrobial Protection for Touch Surfaces to Reduce Hospital Associated Infections

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Outline

- Introduction: ESKAPE(e) Pathogens & Hospital Associated Infections
- Gencoa's iCnano Technology
- Development of Material and Deposition
- Surface Characterisation
- Standard Antibacterial Results from Liverpool School of Tropical Medicine
- *In situ* long term testing by Liverpool School of Tropical Medicine
- Summary and Conclusions

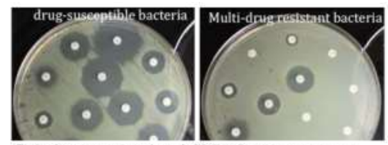
28 Years of Products and Technology from Gencoa

ANTIMICROBIAL PROTECTION FOR TOUCH SURFACES TO REDUCE HOSPITAL ASSOCIATED INFECTIONS

Introduction

- It is estimated that there are at least **100,000 cases of hospital acquired infections (HAI) in England each year**.
- In American hospitals alone, the Centres for Disease Control (CDC) estimates that HAIs account for an estimated 1.7 million infections and 99,000 associated deaths each year.
- **HAIs cost the healthcare system billions of dollars** a year in added expenditure.
- Furthermore, it has been found that a growing number of the pathogens detected have **become resistant to the antimicrobial medications** typically used to control them.

https://e-gis.no/ru/what-are-nosocomial-infections/



Testing the resistance of microbes in the lab. These Petri dishes contain lawns of bacteria cultured from two different clinical samples. The white discs each contain different antibiotics. Where clear zones appear around the discs, bacterial growth has been prevented by the antibiotic. This image has been provided courtesy of Dr. Manfred Brigl and Esperanza Albano of the Clinical Microbiology Laboratory at the Brigham and Women's Hospital, Boston.

https://sitn.hms.harvard.edu/flash/2011/issue103/

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Hospital Associated Infections – ESKAPE(e) Pathogens

- **ESKAPE(e)** pathogens can exacerbate existing or underlying conditions, delay recovery and adversely affect quality of life.
- In 2007, methicillin-resistant *Staphylococcus aureus* (MRSA) bloodstream infections and *Clostridium difficile* infections were recorded as the underlying cause of approximately **9,000 deaths** in hospital and primary care in England. **MRSA** causes more the **80,000 infections** and more than **11,000 deaths** annually in the United States.
- These harmful infections can be contracted through invasive surgical devices such as catheters, however, a large percentage of HAI's are transmissible through **touch surfaces** throughout healthcare settings.

https://cloverbiosoft.com/the-eskape-bacteria-group-and-its-clinical-importance/

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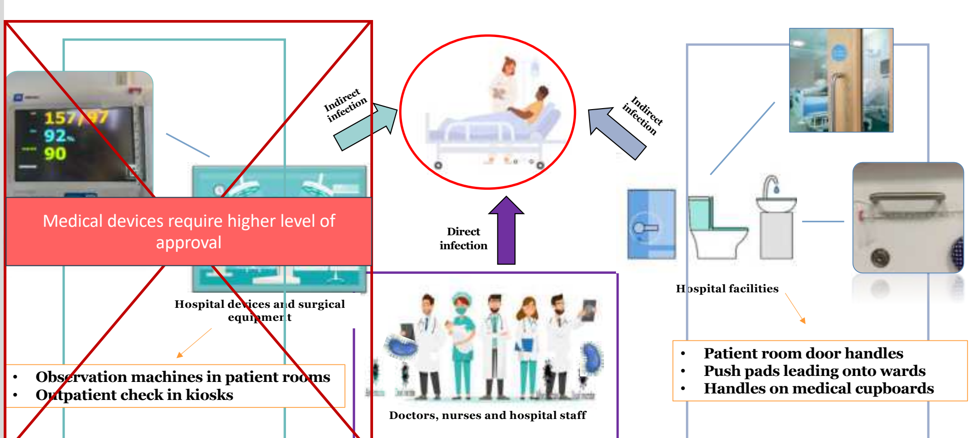
Antimicrobial Protection in Healthcare Settings



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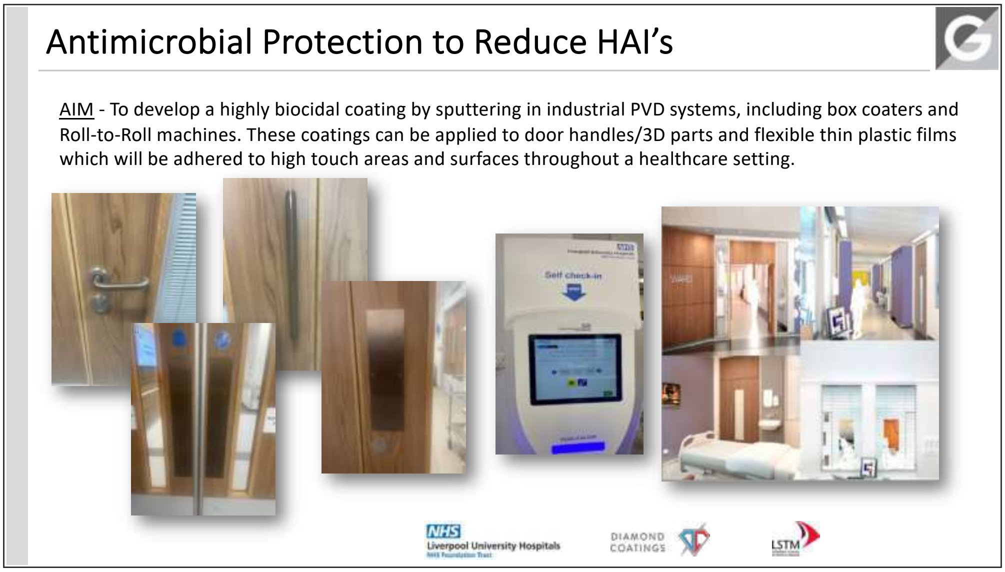
Antimicrobial Protection to Reduce HAI's
AIM - To develop a highly biocidal coating by sputtering in industrial PVD systems, including box coaters and Roll-to-Roll machines. These coatings can be applied to door handles/3D parts and flexible thin plastic films which will be adhered to high touch areas and surfaces throughout a healthcare setting.
Self check-in
NHS
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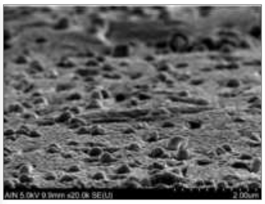
ANTIMICROBIAL PROTECTION FOR TOUCH SURFACES TO REDUCE HOSPITAL ASSOCIATED INFECTIONS

Gencoa's iC-nano Protection

Infection control via nanotechnology

- Gencoa has patented nano-structured coatings for antimicrobial and antiviral applications.
- The layers are opaque, transparent or semi-transparent with varying hardness levels and with killing efficiencies of 99.9999% under standard testing conditions. The coatings are effective in both dark and light environments.



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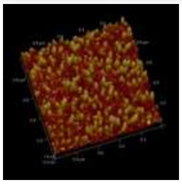
Reactive Sputtering Deposition



Sputtering can create very thin copper-based layers, but also can enhance the performance by using nano-morphology

- Surface morphological features of the order of 10-40nm size have been shown to greatly enhance the antimicrobial performance.

Copper and a wide range of its alloys are the only antimicrobial metal that the US Environmental Protection Agency has approved.

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Deposition Set-up

Step 1

High Vacuum

Background ~10^{-6} mbar

Step 2

Substrate cleaning

Ion Source **IM300**
Used for coating adhesion

Step 3

Active Coating

Gencoa Magnetron
Process Gas
Reactive Gas

Step 4

Feedback Control

OPTIX
Speedflo
Fibre Optic

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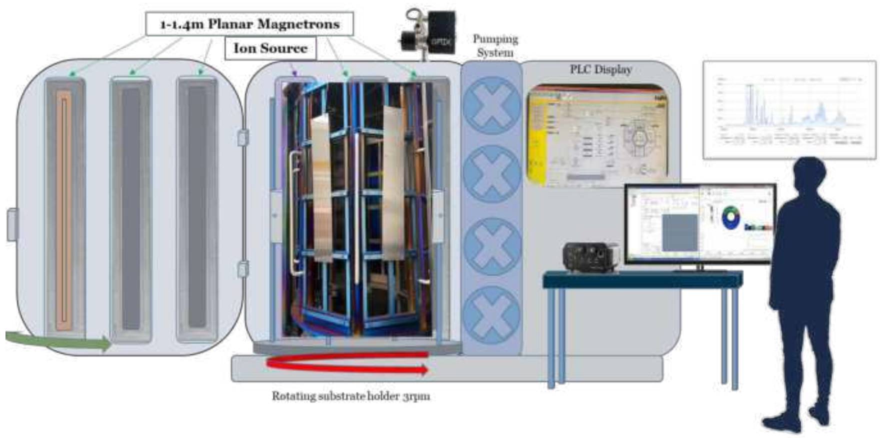
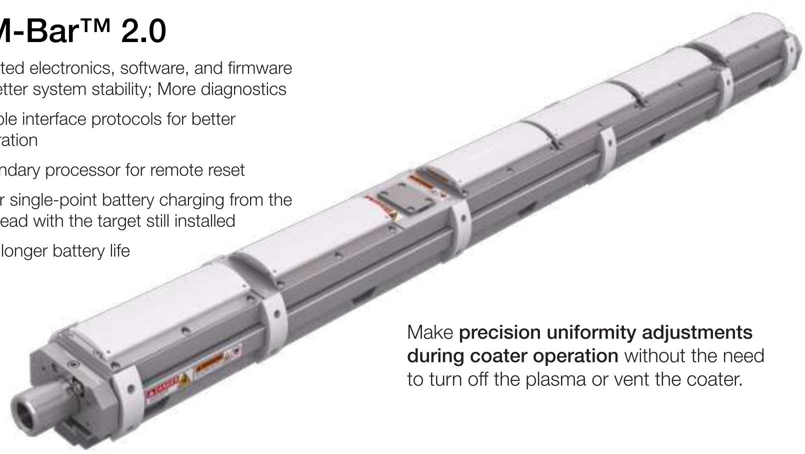
Deposition Chamber



Introducing at SVC TechCon: Booth 907

RAM-Bar™ 2.0

- Updated electronics, software, and firmware for better system stability; More diagnostics
- Multiple interface protocols for better integration
- Secondary processor for remote reset
- Easier single-point battery charging from the bulkhead with the target still installed
- Even longer battery life



Make **precision uniformity adjustments during coater operation** without the need to turn off the plasma or vent the coater.

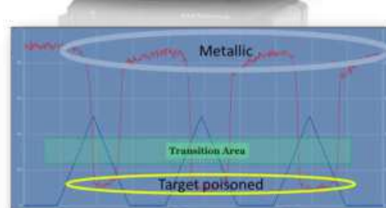
Control Options by Gencoa

Optix

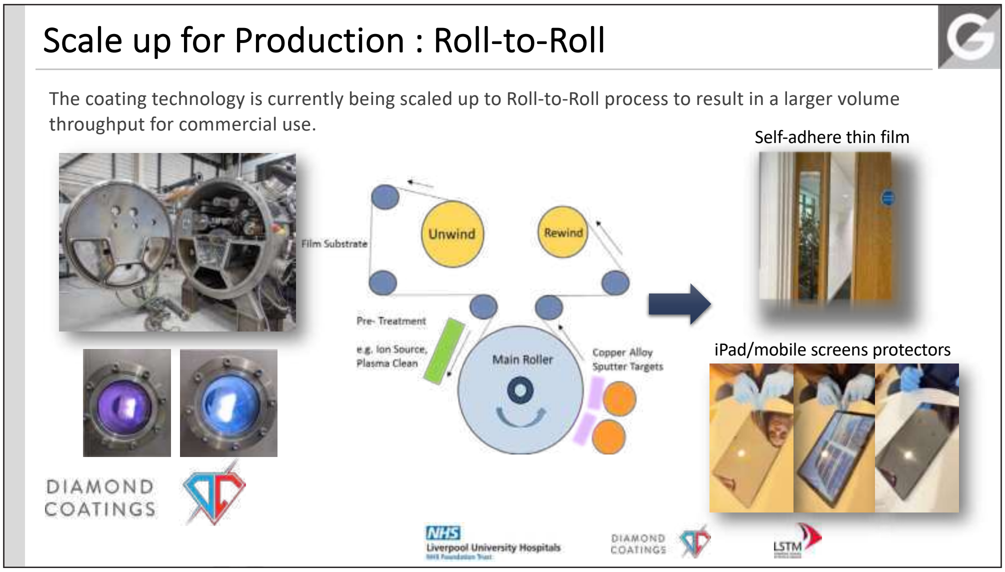
The Optix can measure the real time partial pressures of the gas composition in the chamber.

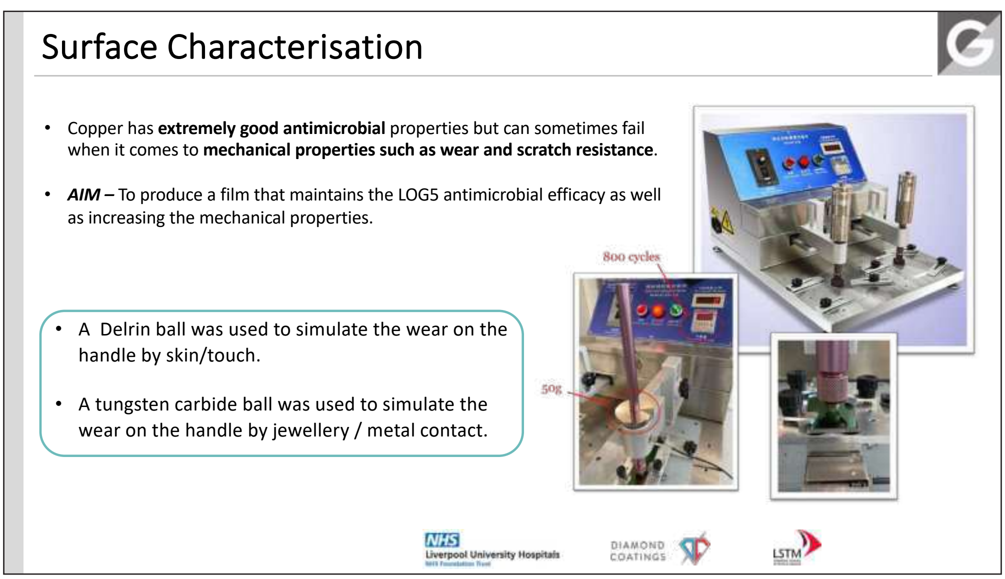
Speedflo mini

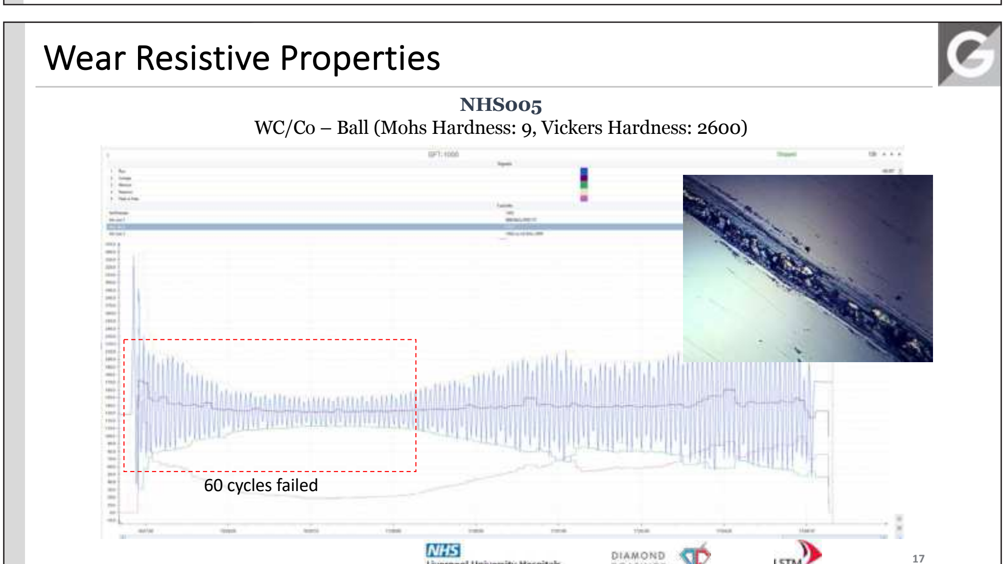
2 sensor inputs
– Target Voltage
- Partial pressure of O_2



ANTIMICROBIAL PROTECTION FOR TOUCH SURFACES TO REDUCE HOSPITAL ASSOCIATED INFECTIONS



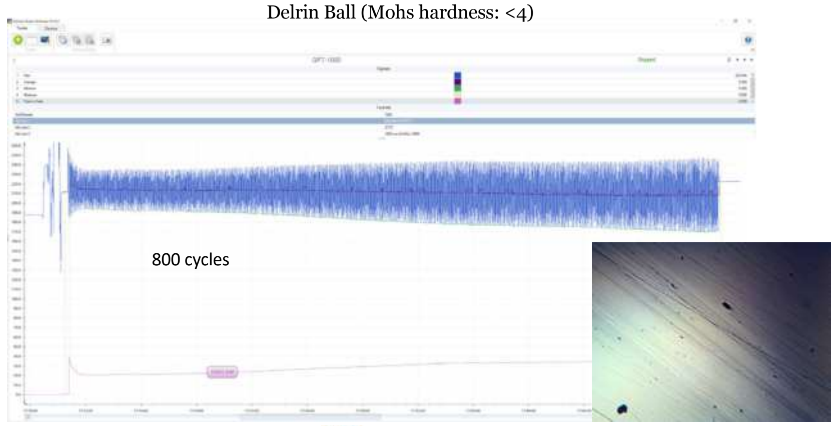




Wear Resistive Properties

NHS005

Delrin Ball (Mohs hardness: <4)



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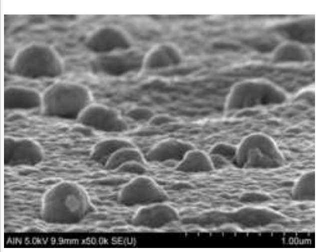
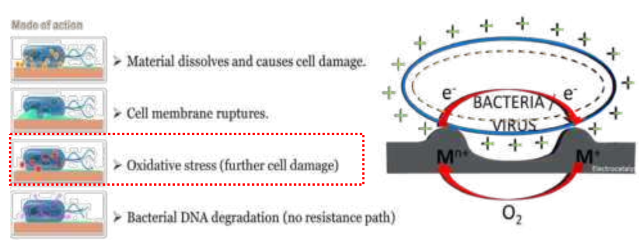
What makes a surface antimicrobial / antiviral?

Electrochemical reaction

$$\text{BACTERIA} + O_2 \xrightarrow{M^{n+}} CO_2$$

The electrocatalyst helps to "oxidize" the microbe or viral material.





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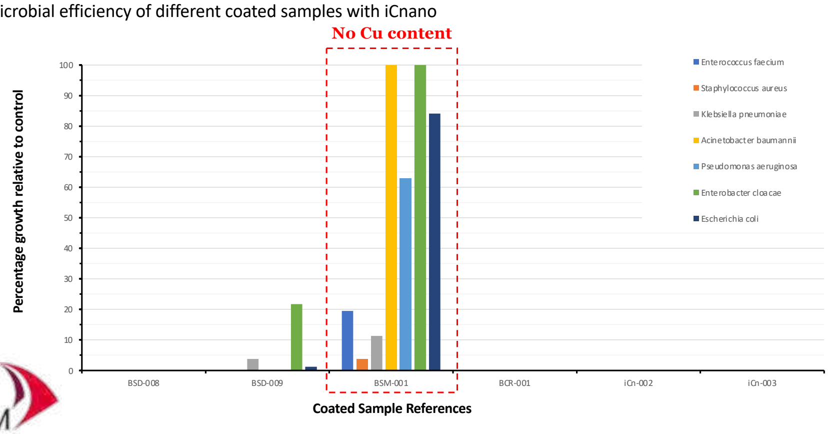
ESKAPE(e) Testing

- Antimicrobial efficiency of different coated samples with iCnano



LSTM

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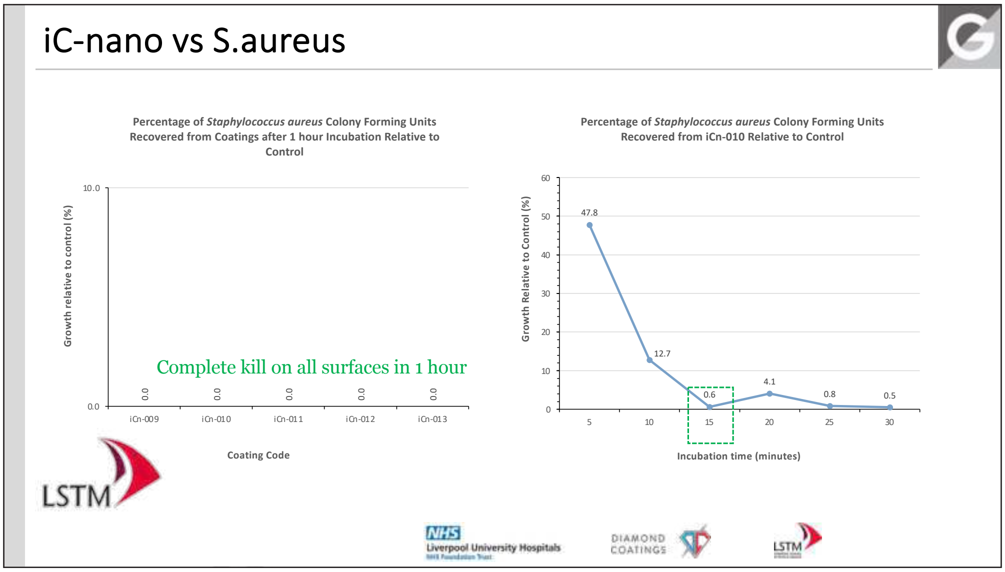
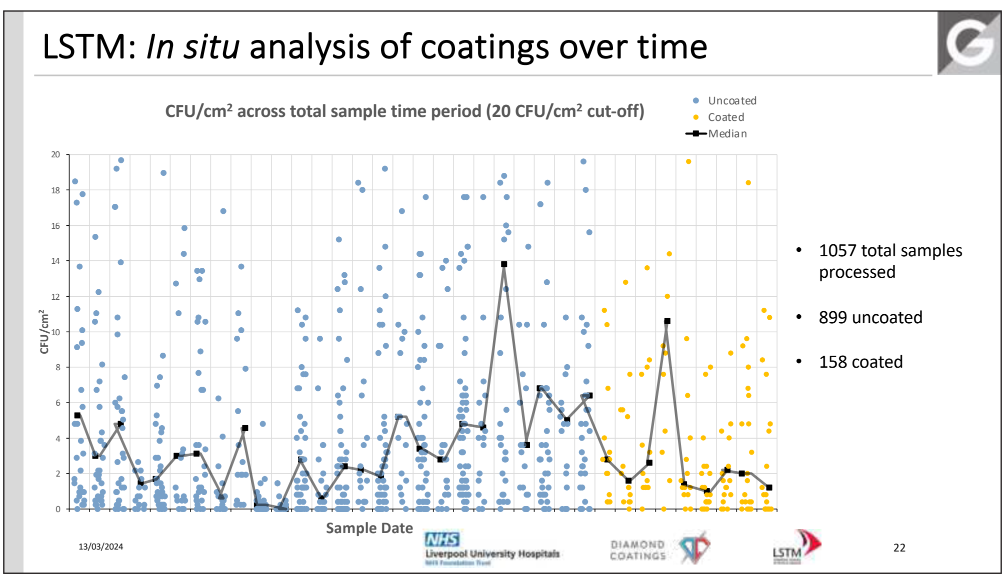
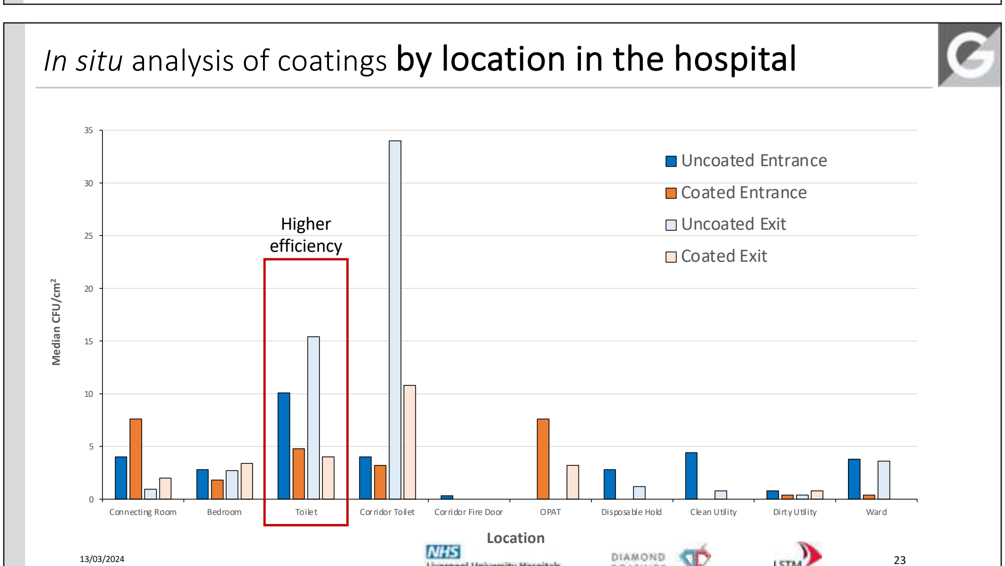
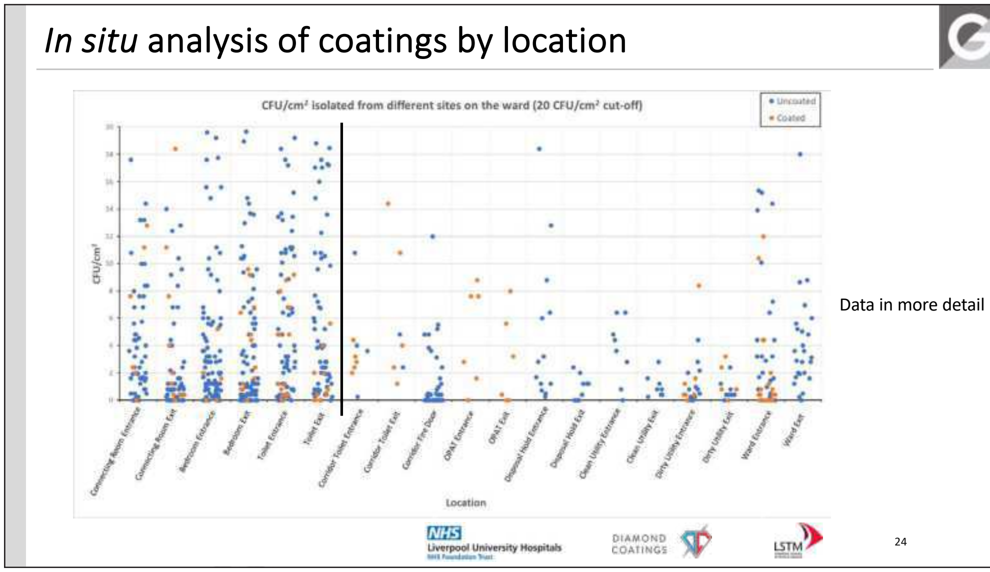

iC-nano vs S.aureus
Percentage of Staphylococcus aureus Colony Forming Units Recovered from Coatings after 1 hour Incubation Relative to Control
Growth relative to control (%)
Complete kill on all surfaces in 1 hour
iCn-009
iCn-010
iCn-011
iCn-012
iCn-013
Coating Code
Percentage of Staphylococcus aureus Colony Forming Units Recovered from iCn-010 Relative to Control
Growth Relative to Control (%)
47.8
12.7
0.6
4.1
0.8
0.5
Incubation time (minutes)
LSTM
NHS Liverpool University Hospitals
DIAMOND COATINGS


LSTM: In situ analysis of coatings over time
CFU/cm² across total sample time period (20 CFU/cm² cut-off)
Uncoated
Coated
Median
CFU/cm²
Sample Date
1057 total samples processed
899 uncoated
158 coated
13/03/2024
22
NHS Liverpool University Hospitals
DIAMOND COATINGS
LSTM


In situ analysis of coatings by location in the hospital
Median CFU/cm²
Higher efficiency
Uncoated Entrance
Coated Entrance
Uncoated Exit
Coated Exit
Connecting Room
Bedroom
Toilet
Corridor Toilet
Corridor Fire Door
OPAT
Disposable Hold
Clean Utility
Dirty Utility
Ward
Location
13/03/2024
23
NHS Liverpool University Hospitals
DIAMOND COATINGS
LSTM


In situ analysis of coatings by location
CFU/cm² isolated from different sites on the ward (20 CFU/cm² cut-off)
Uncoated
Coated
CFU/cm²
Connecting Room Entrance
Connecting Room Exit
Bedroom Entrance
Bedroom Exit
Toilet Entrance
Toilet Exit
Corridor Toilet Entrance
Corridor Toilet Exit
Corridor Fire Door
OPAT Entrance
OPAT Exit
Disposal Hold Entrance
Disposal Hold Exit
Clean Utility Entrance
Clean Utility Exit
Dirty Utility Entrance
Dirty Utility Exit
Ward Entrance
Ward Exit
Location
Data in more detail
NHS
Liverpool University Hospitals
DIAMOND COATINGS
LSTM
24

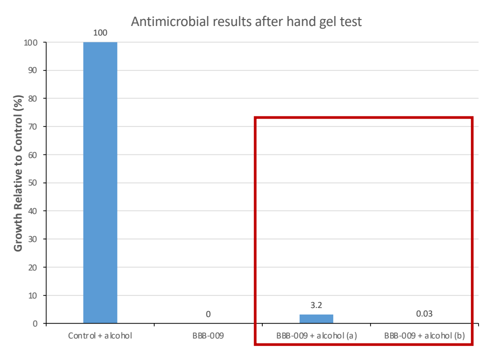
Summary

- HAI's are a leading cause of death worldwide and PVD coatings with antimicrobial properties can be produced on surfaces and disposable films to combat the spread of ESKAPE(e) pathogens throughout healthcare settings.
- Gencoa have developed very thin, mechanically enhanced, antimicrobial surface coatings which can be applied to 3D parts or flexible adhesive films.
- These copper based thin film coatings have been proven to kill 99.9999% (log 6) of the ESKAPE(e) pathogens in both light and dark environments as quickly as 15 minutes.
- The layers are solid state and hard wearing that could last over 10 years based on abrasions tests and simulation.

6th May 2024

The effect of alcohol hand gel on coated surfaces

- Marking and alcohol gel → Not decreasing antimicrobial efficiency
- Environmental effect to be aware of



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Collaborators

LSTM Liverpool School of Tropical Medicine — Dr Adam P. Roberts, Dr Gavin Ackers-Johnson

Innovate UK; iiCON infection innovation consortium

Diamond Coatings — Jason Eite, Ameen Belke, Dr Rick Spencer

NHS Liverpool University Hospitals NHS Foundation Trust — Dr Stacy Todd, Amy Doyle, Danielle McLaughlin

About the Authors:
Lara Maroto-Diaz, Patricia Killen, Dermot Monaghan, Víctor Bellido-Gonzalez, Rick Spencer, Jason Eite, Ameen Belke, Gavin Ackers-Johnson, Adam P. Roberts, Danielle Mclaughlan, Amy Doyle, Stacy Todd

Lara Maroto Diaz studied Telecommunication Engineering and completed a master's degree in Biomedical Engineering at the Public University of Navarre in Spain. Lara started at Gencoa in 2020 as an R&D engineer in the R&D department producing coatings and developing process for customers and projects. One of her main focuses was on the development of sensors for vacuum applications and antimicrobial coatings for high touch surfaces. In July 2024 she moved to the sales department to explore a new role as Technical Sales Engineer.

Victor Bellido-Gonzalez BSc (Hons) Chemistry 1986. He has been R&D Manager at Gencoa Ltd since joining the company in 1996. Victor's experiences of vacuum technology extend back to the late-1980's , and alongside a series of international patents, he has several publications in the field of Inorganic Chemistry, Plasma Assisted Chemical Vapour Deposition (PACVD) and Physical Vapour Deposition (PVD). Some of his main areas of activity extend into product development for new production technologies, involving plasma source development, manufacturing, process control and customer implementation and support. Victor has been directing the biomedical application projects at Gencoa since 2014.

Dermot Monaghan PhD, is the managing director of Gencoa Ltd which he founded in 1994. He completed his first degree in Engineering Metallurgy in 1988 at the University of Salford, UK and his PhD in 1992 in 'the use of unbalanced magnetron sputtering for the formation of novel PVD films' also at Salford University. In 1993 DPM was awarded the C.R.Burch Prize from the British Vacuum Council for 'outstanding research in the field of Vacuum Science and Technology' by a young scientist.

Patricia Killen BEng (Hons) in Mechanical Engineering from Liverpool John Moores University (UK). Started at Gencoa Ltd at the beginning of 2019 as a Process Development Engineer in the R&D Department. Main responsibilities include the development of plasma sources and techniques and working on deposition advancements for the industry, including the development of antimicrobial and antiviral coatings.

Dr Stacy Todd is a Consultant and Co-Clinical Director for Tropical and Infectious Disease Unit, Liverpool University Hospitals. She is a research active NHS clinician with expertise in studies which aim to improve individual patient outcomes while reducing the impact of AMR. Stacy is co-Chief Investigator of the PRONTO Trial, one of the largest ever sepsis studies ran in the UK.

SOCIETY OF VACUUM COATERS FOUNDATION
- Established 2002 -

THANK YOU!

The SVCF Board of Directors would like to thank the following companies for their generous sponsorships for Casino Night 2025!

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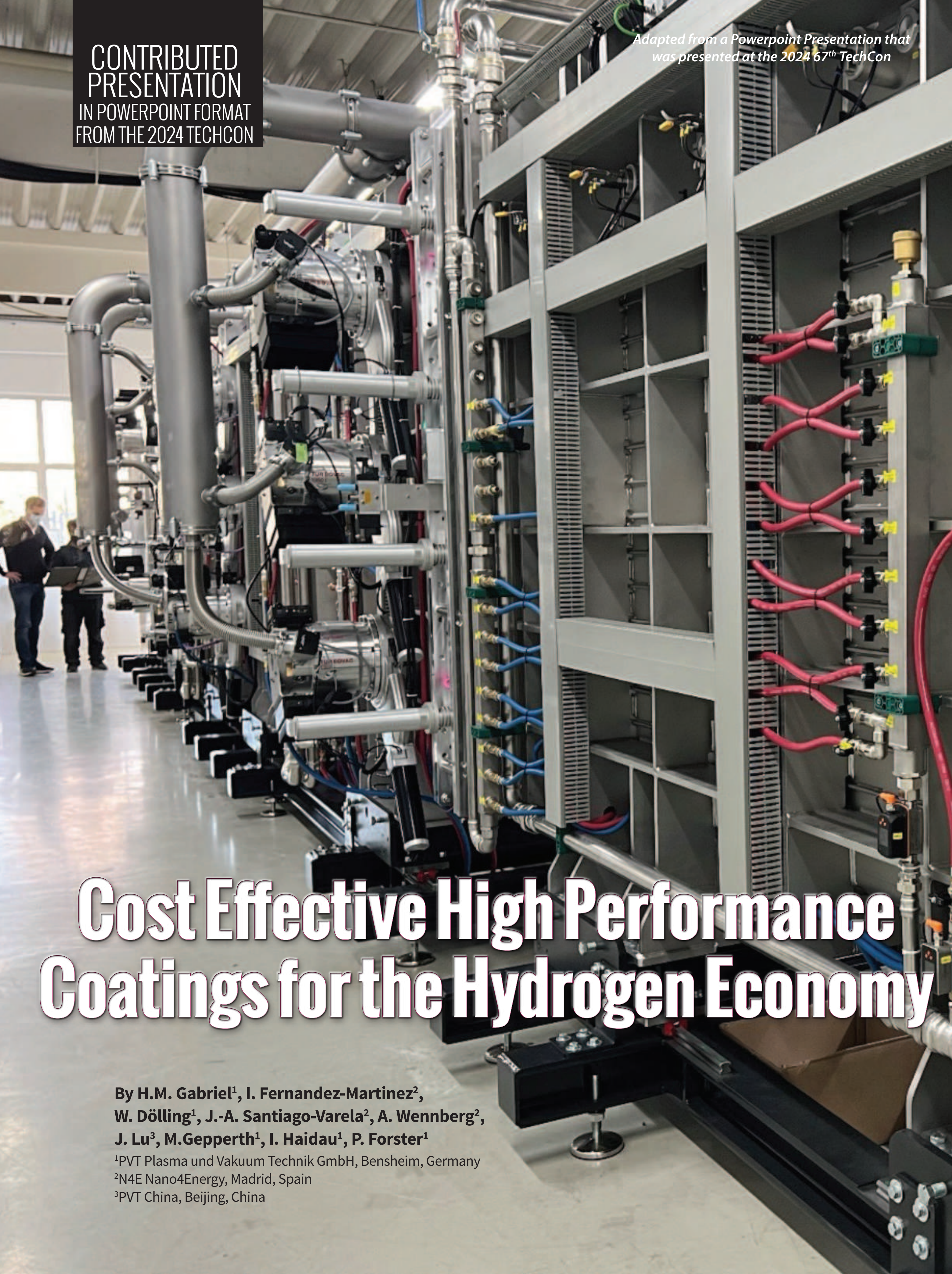
GENCOA

DHF Technical Products
Outstanding in every element.



Adapted from a Powerpoint Presentation that was presented at the 2024 67th TechCon

Cost Effective High Performance Coatings for the Hydrogen Economy

By H.M. Gabriel[1], I. Fernandez-Martinez[2], W. Dölling[1], J.-A. Santiago-Varela[2], A. Wennberg[2], J. Lu[3], M.Gepperth[1], I. Haidau[1], P. Forster[1]

[1]PVT Plasma und Vakuum Technik GmbH, Bensheim, Germany
[2]N4E Nano4Energy, Madrid, Spain
[3]PVT China, Beijing, China

COST EFFECTIVE HIGH PERFORMANCE COATINGS FOR THE HYDROGEN ECONOMY

In-line coating systems are ideally suited for high volume production applications over a wide range of substrate sizes and geometries. Parts are fed in on one side of the coating plant, run through the various process chambers and are finally released to atmosphere at the other end of the coating system.PVT has designed and developed different in-line coating systems that are ideally suited for Physical Vapor Deposition (PVD) coating of bipolar plates for fuel stacks and electrolyzers in high volume. In-line coating systems are characterized by the ability to perform each step of the coating process in its own dedicated vacuum chamber. Process chambers are isolated from each other by large area transfer valves.Multi-layer film stacks are deposited in a highly productive process cycle. PVT will present its newest in-line system which is extremely productive and versatile using magnetron sputtering and HiPIMS.PVT is offering coating service with this in-line system for development and pilot production applications. Properties of the different coatings deposited by HiPIMS and dual magnetron sputtering are presented such as ICR – values and corrosion data.

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Sue Taube/Managing Editor

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https://www.svc.org
DOI: https://doi.org/10.14332/svc24.proc.0043

Cost-effective High Performance Coatings for the H_2 – Economy

by PVT Plasma und Vakuum Technik

PVT | People with Vision and Technology

Content

- **Introduction of company**
  - **Scope of business, Deposition processes,**
  - **Hard coatings for cutting tools**
- Hydrogen Economy
  - Processes, Coatings, in-line coating equipment
- H_2 – applications, coatings and trends
- i-L3.5000 in-Line coating system
  - Coating service for the H_2 -Industry

PVT | People with Vision and Technology

- Founded in 1985
- Headquarter in Bensheim near Frankfurt, Germany

COST EFFECTIVE HIGH PERFORMANCE COATINGS FOR THE HYDROGEN ECONOMY

PVT | Scope of our business

Development of

- Coating processes
- Coatings

Design and Manufacture

- Coating systems

Coating Service (Development, start-up production)

Provide Turnkey Coating Solutions

PVT | Wide Range of Vacuum Coating Processes

- **Arc-Evaporation HiPArc***
- Magnetron-Sputtering
- **HiPIMS High Power Impulse Magnetron-Sputtering**
- **HiPIMS V⁺ with positive reverse pulse**
- PECVD
- Hybrid PP (Pulse Plasma Nitriding + HiParc)

* HiPArc = High Power Pulsed Arc

PVT | Coating Systems

Arc Evaporation

xPro-S3

xPro-M3

xPro-L4

Magnetron Sputtering

xPro4C - planar

xPro4R - rotatables

PVT | Tallest coating systems for broaches

Total system height: 4.2m

Total usable size: 460mm x 3000mm

Max. weight of substrates: 2000 kg

PVT |

xPro – Serie (eXtended PROductivity)

TiN;
TiC,N;
AlTiN; e.g. AlTi 70/30, 67/33, 65/35, 60/40, 50/50
AlCrN;
CrN;
Si – doped
B - doped
Ti – nitrides
Al – Ti – nitrides
Al – Cr – nitrides
Al – Cr – Ti – nitrides
etc.
0.5 – 10 µm

- **All our coatings are nano-structured multilayers**
- **Smallest tool diameter 0.1 mm**

PVT | People with Vision and Technology

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COST EFFECTIVE HIGH PERFORMANCE COATINGS FOR THE HYDROGEN ECONOMY

PVT | Bipolar Plates

PVT

- **Requirements**

DOE	**ICR**	**< 10 mOhm cm²**
	Corrosion	**< 1 µA/cm²**
Lifetime		**>/= 10.000 h**
		>/= 30.000 h (heavy duty)

- **Complex Coating structures**

  Multi-layers **10 nm – 2 µm (2.000 nm)**

PVT | Processes and Coatings for BiPs

PVT

Processes

- Arc evaporation
- **HiPIMS and DMS (Dual Magnetron Sputtering)**

Coatings

- Gold
- **Metal / Metal nitrides plus noble metal**
- DLC, doped
- **Others (determined by Customer)**
- **Others (determined by application)**

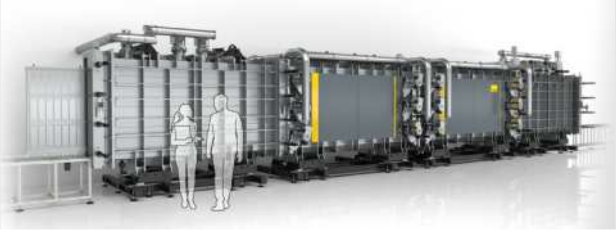
- **Most different coatings / coating structures**

PVT | PVD in-line coating systems for BiPs

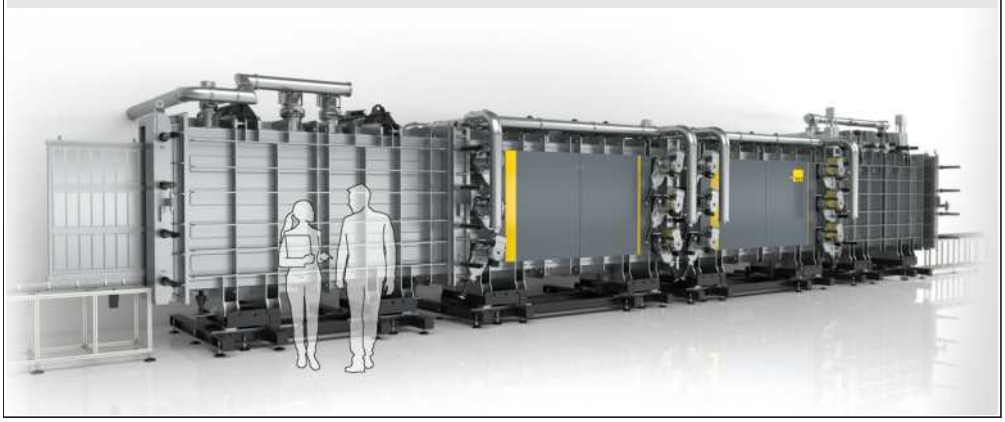
PVT

- **i-L 3.5000 3 chambers,2.000.000 BiPs/year**
  - **frame 1.800 x 1.000 mm**

- **i-L 4.3500 4 chambers, 5.000.000 BiPs/year**
  - **frame 3.500 x 1.500 mm**



PVT | In-line –System i-L 4.3500



PVT | In-line –System i-L 4.3500

PVT | In-line –System i-L 4.3500

3.5 x 1.5 m	Size of transport frame into chamber
445 x 132 mm	Size of bipolar plates
69 pcs	Bipolar plates every 6 minutes
500 nm	Double layer coating
5.000.000 pcs	**Bipolar plates/year**

CONTRIBUTED PRESENTATION IN POWERPOINT FORMAT FROM THE 2024 TECHCON

COST EFFECTIVE HIGH PERFORMANCE COATINGS FOR THE HYDROGEN ECONOMY

PVT | People with Vision and Technology

PVT

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PVT | Applications

PVT

- **What kind of products can we coat ?**

PEMFC

PEMWE

Alkaline electrolyzers

SOFC

SOEC

????

PVT | Coatings II

PVT

COATINGS FOR HYDROGEN APPLICATIONS

APPLICATIONS		COATINGS
PEM FC		Carbon
		Metal or Metal-Nitride + Noble Metal
PEM WE stainless, Ti	Anode	Corrosion-barrier layer + Noble Metal (Pt or Ir)
	PTL (mesh)	Pt
	GDL	Pt
	Cathode	Carbon
Alkaline electrolyzers	Plates	Ni-based
	PTL	Ni / Ni-Iron
SOFC	Interconnects	MCO, Ni, CeO, Al_2O_3
	Solid Electrolyte	YSZ or doped-CeO_2

PVT | Trends for coatings of BiPs for Fuel Cells

- DLC is clear favorite
  Cheap material
  Easy to deposit
  max. 10.000 h lifetime

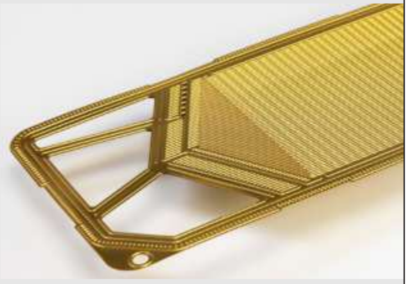
versus

- Metal / metal – nitrides + Noble Metal
  Expensive material (Ir or Pt)
  Long lifetime 20 - 30.000 h +

PVT | Trends for coatings of BiPs for Electrolyzers

Currently

- Ti – based substrate + noble metal
  long lifetime
  very expensive



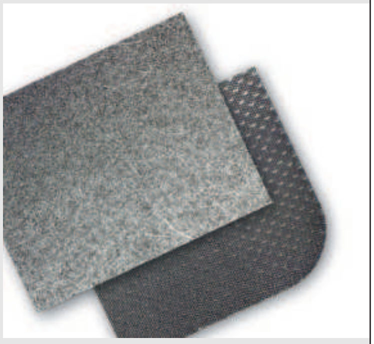
versus

- Stainless steel + multilayer coating
  Metal / metal-nitride + Noble metal
  Expensive material (Ir or Pt)
  Significantly cheaper

PVT | Trends for coatings of PTLs and GDLs for Electrolyzers

Currently

- Ti – based substrate + noble metal
  200 nm Pt (electro-plated)
  very expensive



versus

- Ti – based substrate + noble metal
  20 nm Pt (HiPIMS and DMS)
  Significantly cheaper

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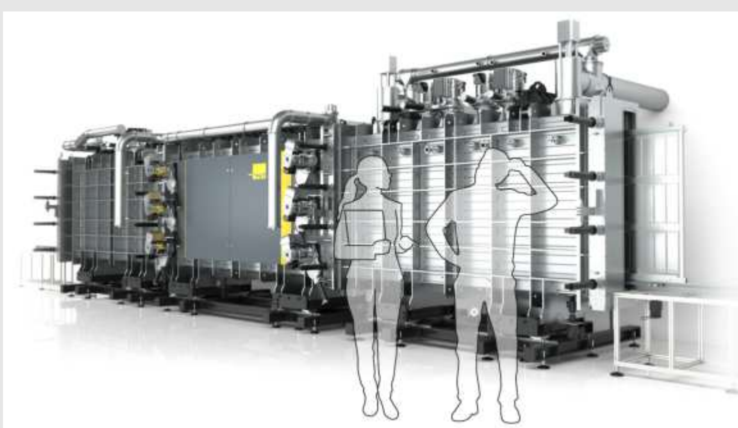
  - **Coating service for the H_2 -Industry**

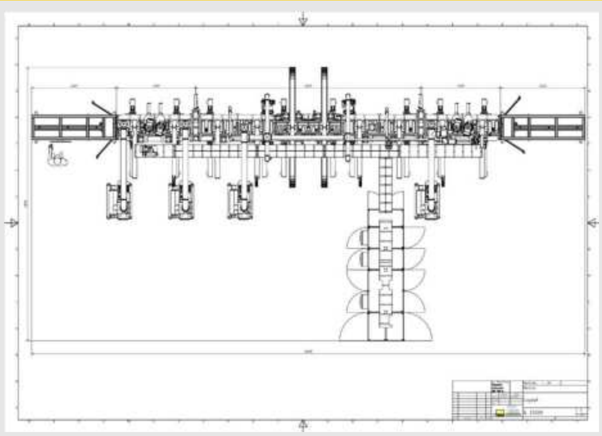
PVT | In-line –System i-L 3.5000



PVT | In-line –System i-L 3.5000

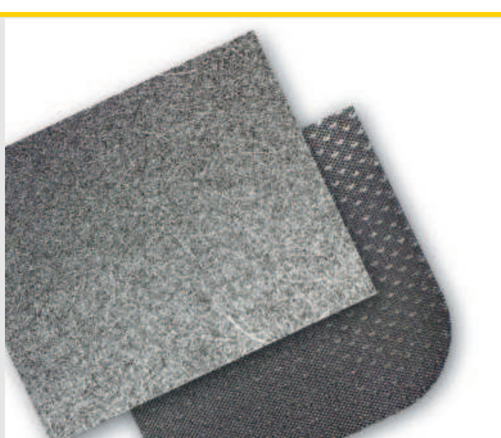
PVT | In-line –System i-L 3.5000

PVT | In-Line System i-L 3.5000



- i-L 3.5000
- In-line system
- Capacity
  - up to 2.000.000 pcs/year
- 500 x 125 mm

PVT | In-line –System i-L 3.5000



COST EFFECTIVE HIGH PERFORMANCE COATINGS FOR THE HYDROGEN ECONOMY

PVT | In-line –System i-L 3.5000

PVT

Corrosion test (80°C) of coated stainless steel*

test conditions	testing time	average of final hour of test
0.8 V	0 hr - 24 hr	8.9×10^{-9} A cm^2
1.6 V	24 hr - 34 hr	9.5×10^{-6} A cm^2

* at 0.1 ppm HF + H_2SO_4 (pH = 3) hydrofloric acid + sulfuric acid

Contact Resistance ICR of Pt on stainless steel**

test conditions	before corrosion test	after corrosion test
0.8 V for 24h + 1.6V for 1h	1.40 mΩ cm^2	2.95 mΩ cm^2
0.8 V for 24h + 1.6V for 10h	1.20 mΩ cm^2	3.10 mΩ cm^2

** at 0.6MPa

PVT |

PVT

CONTRIBUTED PRESENTATION
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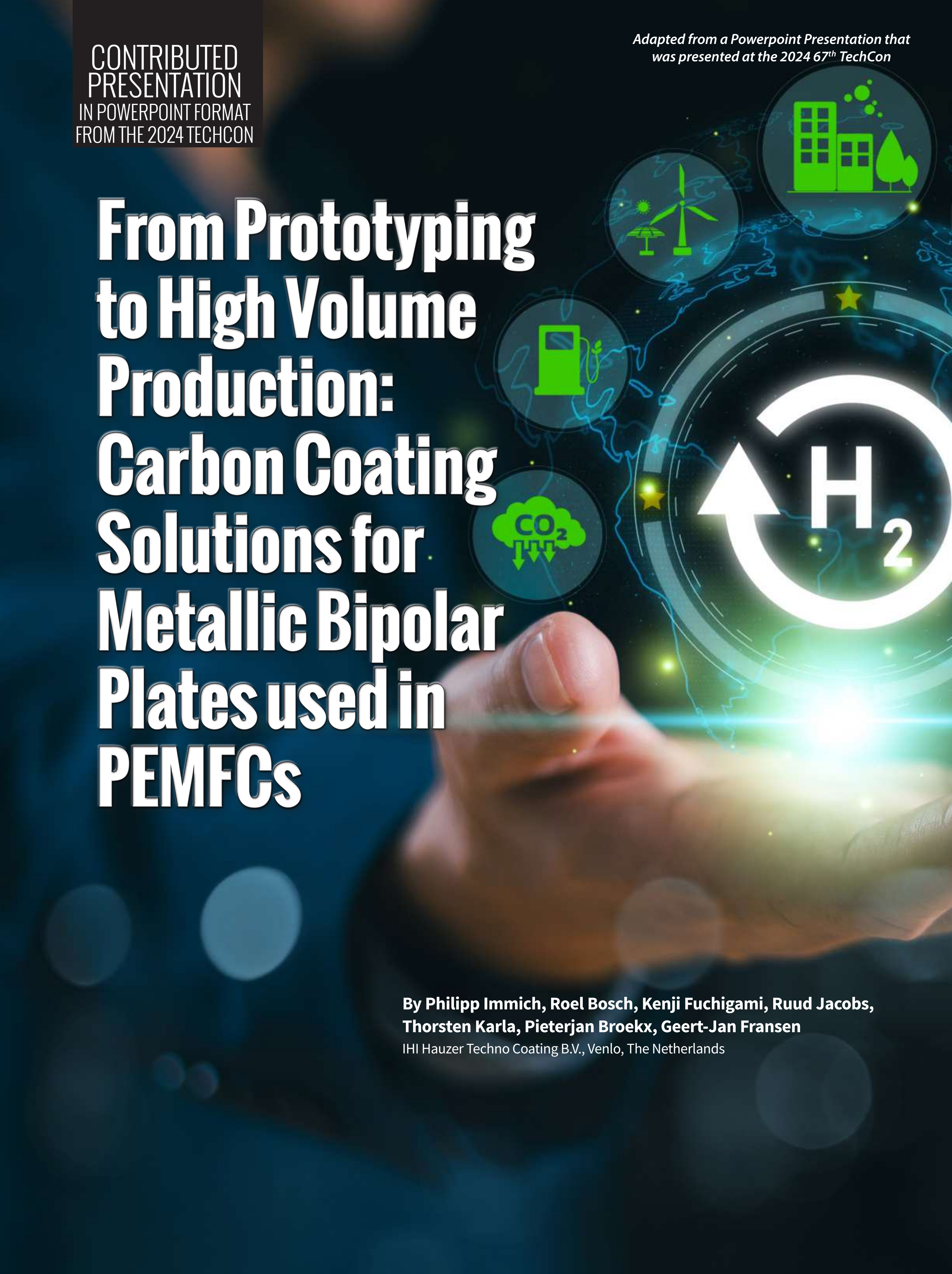

From Prototyping to High Volume Production: Carbon Coating Solutions for Metallic Bipolar Plates used in PEMFCs

By Philipp Immich, Roel Bosch, Kenji Fuchigami, Ruud Jacobs, Thorsten Karla, Pieterjan Broekx, Geert-Jan Fransen

IHI Hauzer Techno Coating B.V., Venlo, The Netherlands

The hydrogen market is growing rapidly. The industry is developing for technical solutions for hydrogen generation and hydrogen-based electricity generation for mobile and stationary applications, and universities and institutes are investigating solutions for the long term. Today's challenge is to bridge the gap between current low to medium technology maturity level and market demand: how to be able to produce hydrogen on large scale and how to scale fuel cell production to high volumes? IHI Hauzer is working on this challenge for many years, developing low cost coatings to supply to the market either by machine solutions and coating services. Key components of electrolyzers and fuel cell stacks like bipolar plates, PTL sheets and CCM's need high quality coatings to enable good catalyst performance, good electrical conductivity and good corrosion properties. For bipolar plates and PTL sheets, Hauzer has developed coatings based on PVD technology. In the presentation the actual state of the art will be addressed, including the current status of market introduction and our expected further roll-out within the next years. For PVD, the current main challenges related to machine and process solutions for high speed inline coating will also be addressed. We will further address the requests from the market especially the electrolyzer business and give an outlook about possible solutions to serve these demands.

FROM PROTOTYPING TO HIGH VOLUME PRODUCTION: CARBON COATING SOLUTIONS FOR METALLIC BIPOLAR PLATES USED IN PEMFCS

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https://www.svc.org DOI: https://doi.org/10.14332/svc24.proc.0044


HAUZER
INDUSTRIAL PLASMA SOLUTIONS
- FROM PROTOTYPING TO HIGH VOLUME PRODUCTION -
Carbon coating solutions for metallic bipolar plates used in PEMFC's
New developments for PEM Electrolyzers
IHI Hauzer Techno Coating B.V.
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WE ADAPT, INNOVATE AND PERFORM. CONTINUOUSLY. TOGETHER.
WE ENGINEER COATING SOLUTIONS FOR LIFE.
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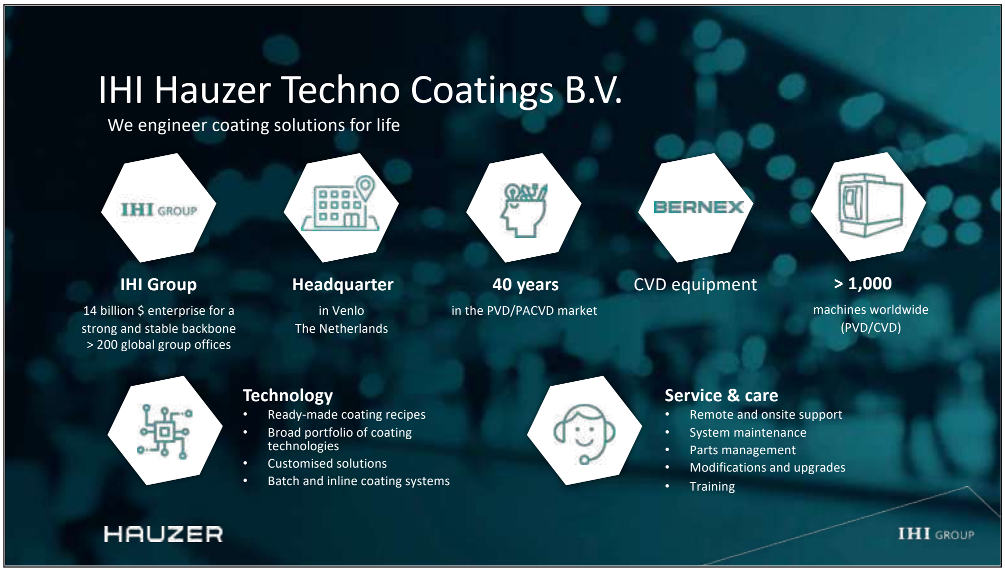
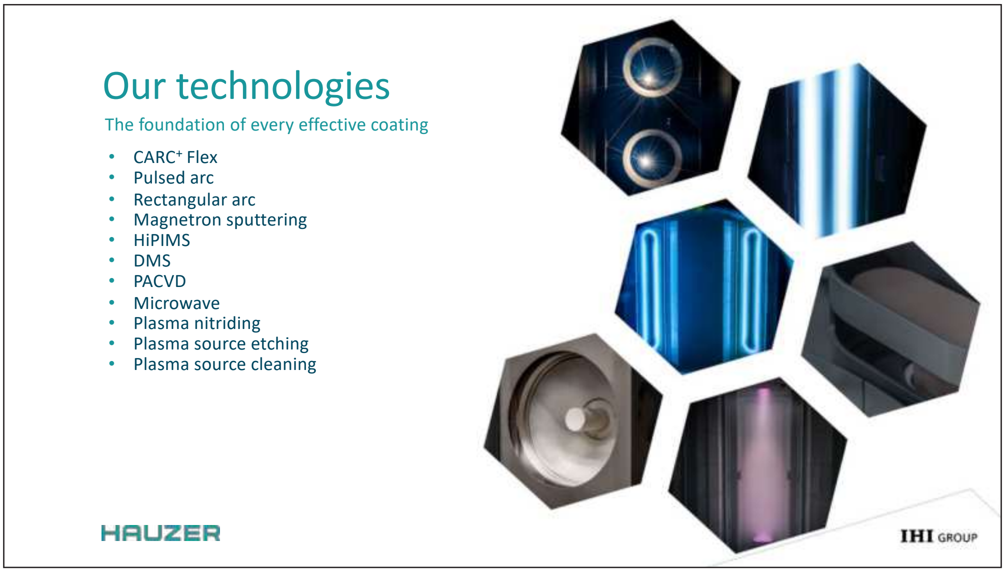
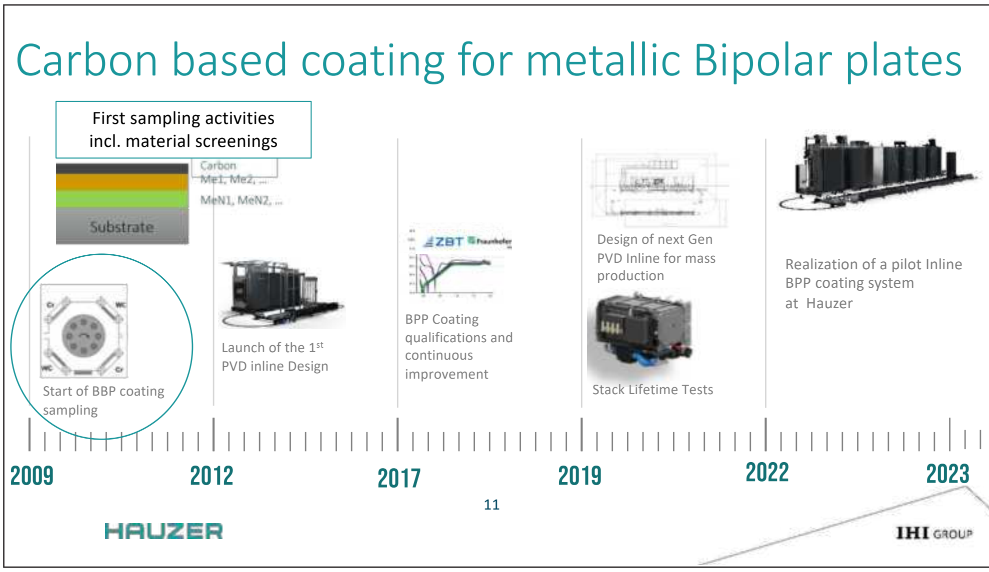
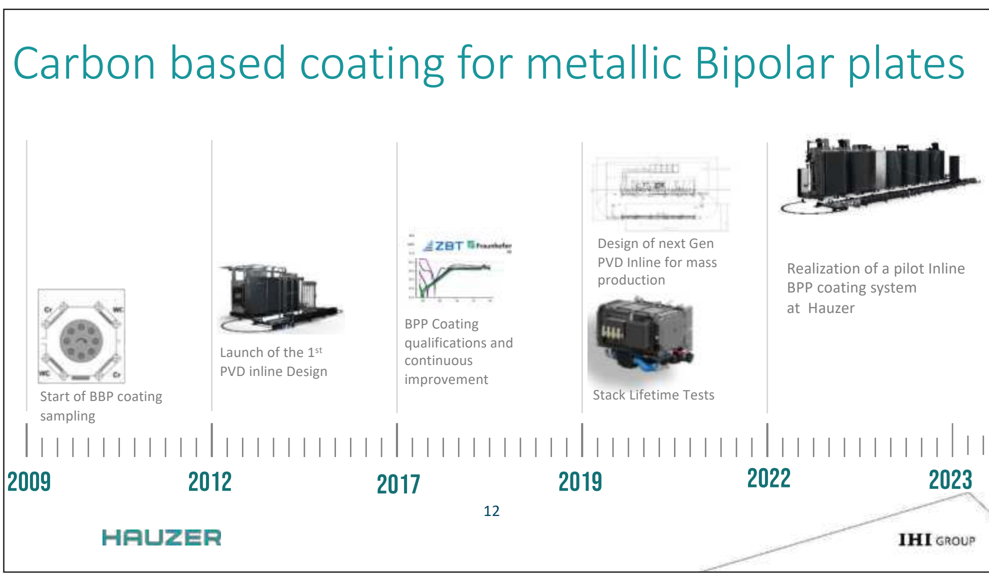

IHI Hauzer Techno Coatings B.V.
We engineer coating solutions for life
IHI GROUP
IHI Group
14 billion $ enterprise for a strong and stable backbone
> 200 global group offices
Headquarter
in Venlo
The Netherlands
40 years
in the PVD/PACVD market
BERNEX
CVD equipment
> 1,000
machines worldwide (PVD/CVD)
Technology
Ready-made coating recipes
Broad portfolio of coating technologies
Customised solutions
Batch and inline coating systems
Service & care
Remote and onsite support
System maintenance
Parts management
Modifications and upgrades
Training
HAUZER
IHI GROUP

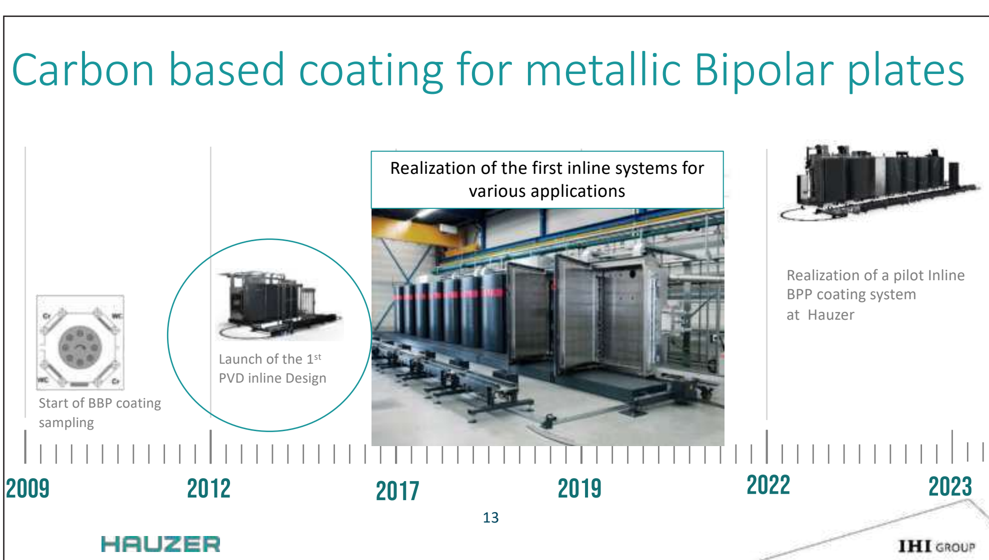
FROM PROTOTYPING TO HIGH VOLUME PRODUCTION: CARBON COATING SOLUTIONS FOR METALLIC BIPOLAR PLATES USED IN PEMFCS

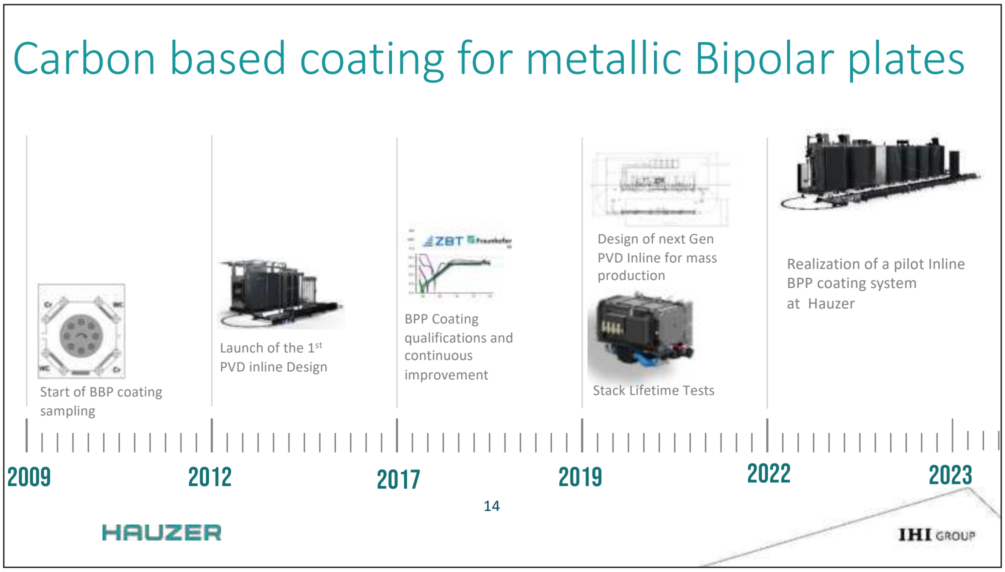


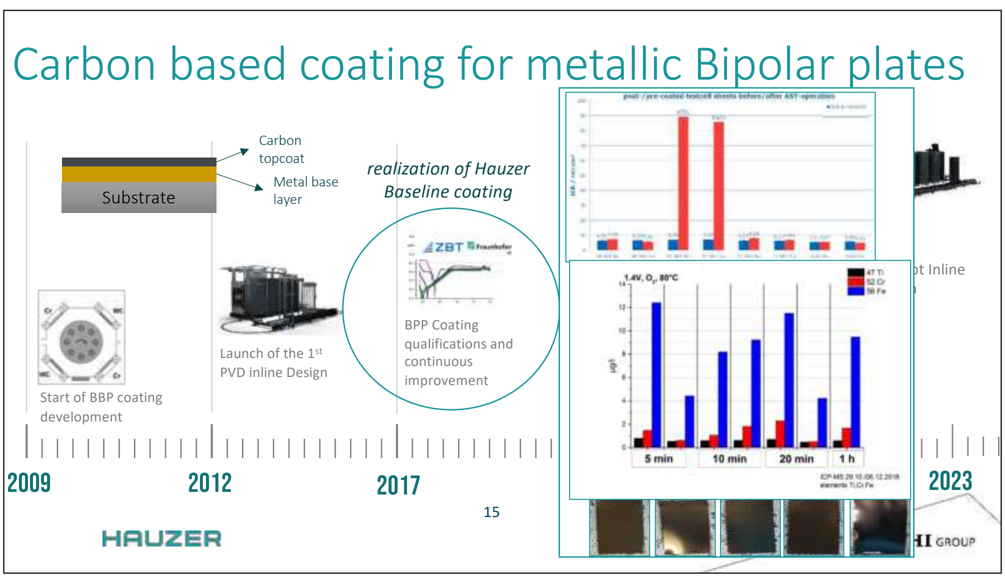
FROM PROTOTYPING TO HIGH VOLUME PRODUCTION: CARBON COATING SOLUTIONS FOR METALLIC BIPOLAR PLATES USED IN PEMFCS

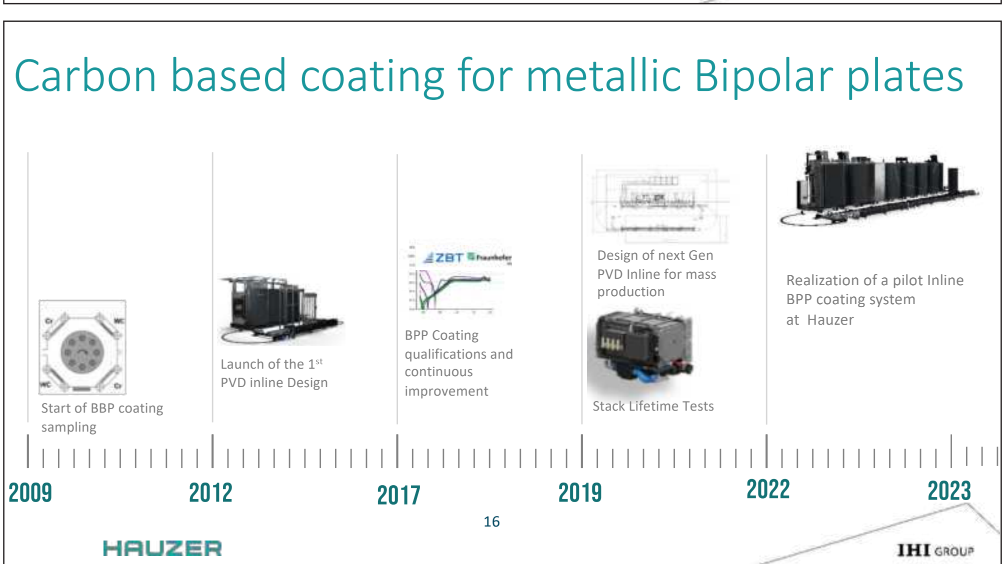







Carbon based coating for metallic Bipolar plates
Start of BBP coating sampling
Launch of the 1st PVD inline Design
BPP Coating qualifications and continuous improvement
Design of next Gen PVD Inline for mass production
Stack Lifetime Tests
Realization of a pilot Inline BPP coating system at Hauzer
2009
2012
2017
2019
2022
2023
14
HAUZER
IHI GROUP


Carbon based coating for metallic Bipolar plates
Substrate
Carbon topcoat
Metal base layer
realization of Hauzer Baseline coating
Start of BBP coating development
Launch of the 1st PVD inline Design
BPP Coating qualifications and continuous improvement
1,4V, O2, 80°C
5 min
10 min
20 min
1 h
2009
2012
2017
2023
15
HAUZER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2009
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2019
2022
2023
16
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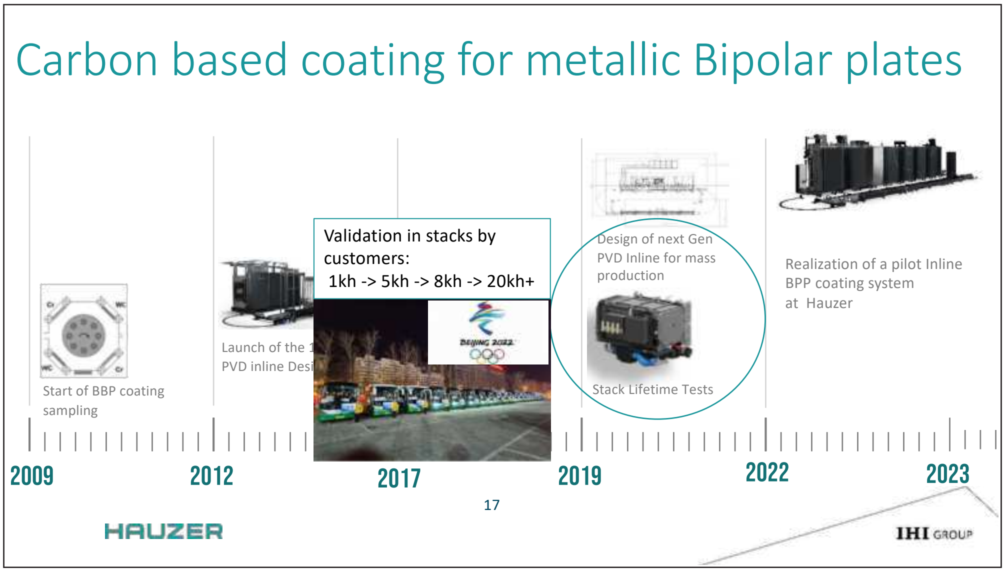
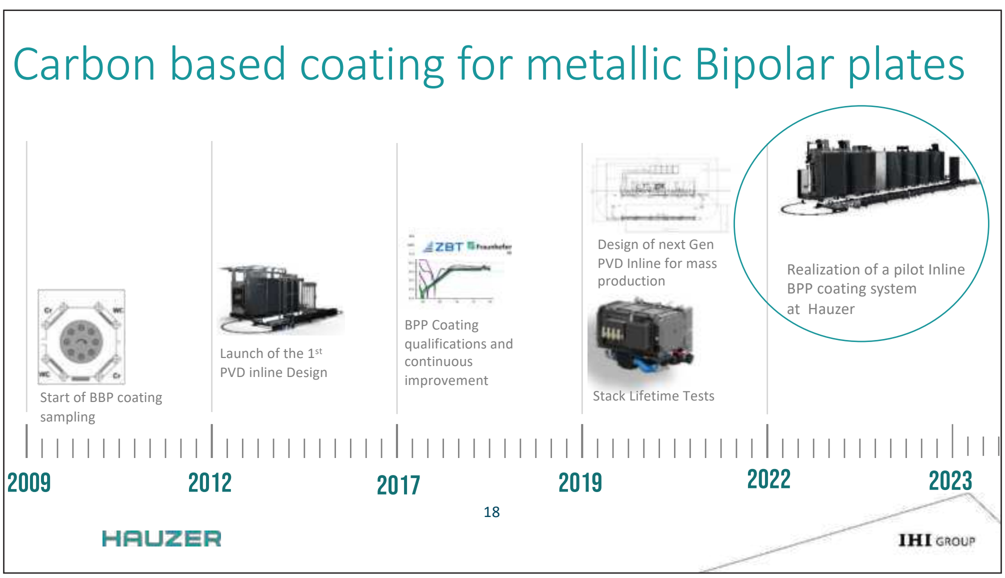
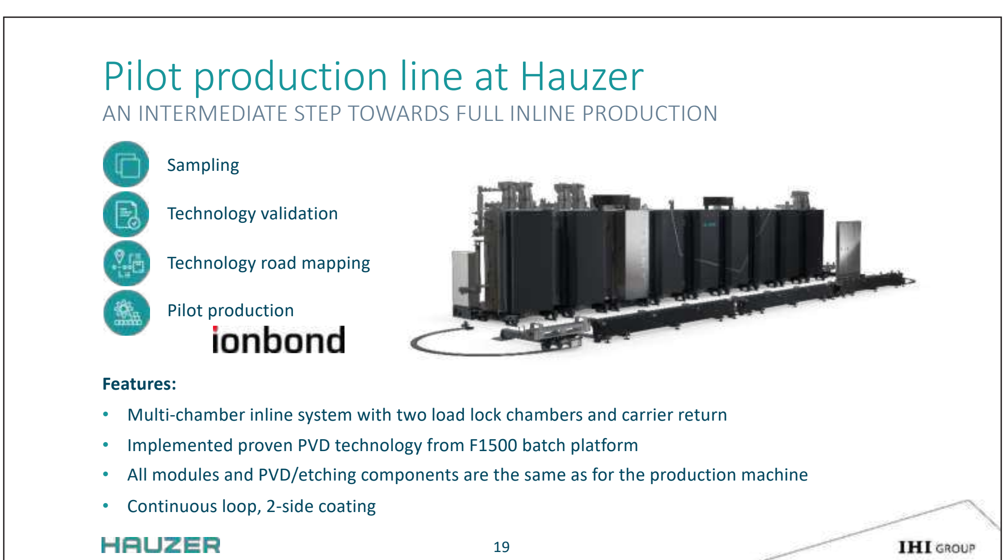
FROM PROTOTYPING TO HIGH VOLUME PRODUCTION: CARBON COATING SOLUTIONS FOR METALLIC BIPOLAR PLATES USED IN PEMFCS

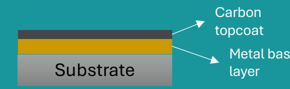






HAUZER'S COATING SOLUTIONS

- Based on a Carbon topcoat with a metal base layer
- Currently we are in the implementation phase for OEM, 1st and 2nd tier suppliers in **Europe, the US and Asia**
- Latest Interfacial Contact Resistance (ICR) measurements shows that we **are below 3mΩ*cm2** (US DoE set benchmark on 10mΩ*cm2)
- Durability test at 1st tier automotive supplier
  - 1st test was extended from **5,000 to 6.200 hours**
  - Test was stopped at more than **8.000 hours** since the result was sufficient. Customers estimated a lifetime of more than **25,000 hours**
  - Confirmation of **20,000** (and counting) by a Chinese customer



ICR Test system with BPP

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INTERFACE CONTACT RESISTANCE (ICR)

- Constant ICR-level measured on metallic (316L) bipolar plates
- coated with our carbon coating on our pilot inline machine in Venlo, the Netherlands
- 6 months production period
- The red line shows the required ICR-level, specified by our customer.

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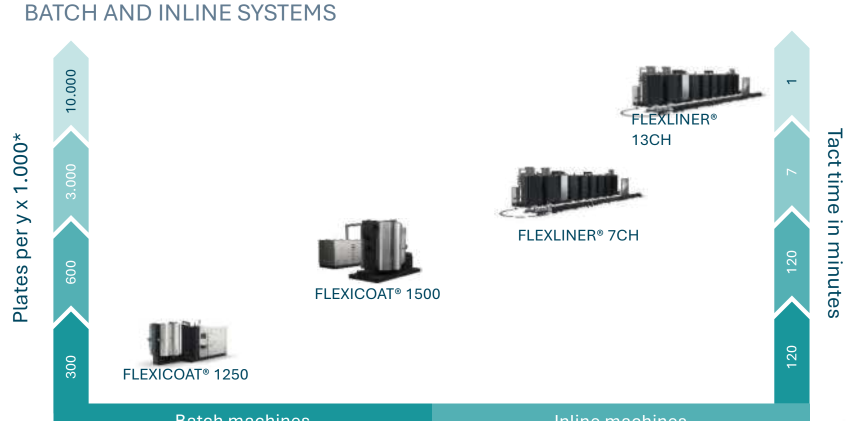
Portfolio of BPP coating equipment

BATCH AND INLINE SYSTEMS



HAUZER

** = depending on plate size and local conditions **(#Shifts, h/week, working weeks etc.)***
Detailed TCO model for inhouse-production is available,

IHI GROUP

FROM PROTOTYPING TO HIGH VOLUME PRODUCTION: CARBON COATING SOLUTIONS FOR METALLIC BIPOLAR PLATES USED IN PEMFCS

Coatings for PEMWE


GEN0 – uncoated Ti


GEN1 –Ti with noble metal coating


GEN2 –Ti with xx coating


GEN3 –SS with xx coating

- PEM Electrolyzer market is growing rapidly
- Today's BPP material is Ti, uncoated ("GEN0") or coated with noble metals ("GEN1")
- **Investment levels for noble metals is an issue**
- Finding an alternative lower-cost coating to noble metals ("GEN2") will help accelerating the market.
- Final goal is to use low cost BPP material like stainless steel ("GEN3"), developing a protective **coating for stainless steel is a challenge but will finally be overcome**
- Hauzer is working on **PVD based solutions lower cost solution**.

HAUZER 23

Coating equipment concepts / options

Starting Points:

- Plate size: 750 x 500 mm
- Substrate thickness: 0,070 – 2 mm (thicker plates possible)
- Substrate alloy: Titanium
- Several deposition technologies possible
- Deposition of noble metal replacement or (optional) noble metals
- Plasma etching
- Layer thickness max 50nm
- Single- and double-sided coating

	Flexicoat® 1500Max	4CH Flexliner®	7CH Flexliner®
Tact time in minutes	2 x 60	12	5
Plates per year *	> 36.000	> 146.000	> 350.000
Batch load	10	4	4
	• Short leadtime • Max. Flexibility • CARC⁺ and planar cathodes	• Short leadtime • CARC⁺, round and planar cathodes • Small floor space	• Highest productivity • CARC⁺, round and planar cathodes

** = depending on plate size and local conditions **(#Shifts, h/week, working weeks etc.)**, Detailed TCO model for inhouse-production is available*

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HYDROGEN COMBUSTION

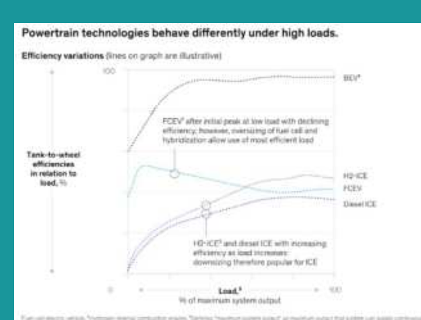
\+ no pure hydrogen required → less expensive hydrogen

\+ low dependence on noble- and rare earth metals

\- Hydrogen storage/energy density

Coating requirement:

- Low friction coatings (no lubrication effect)
- High temperature resistant coatings (direct exposure to combustion process)
- Hydrogen barrier coatings?



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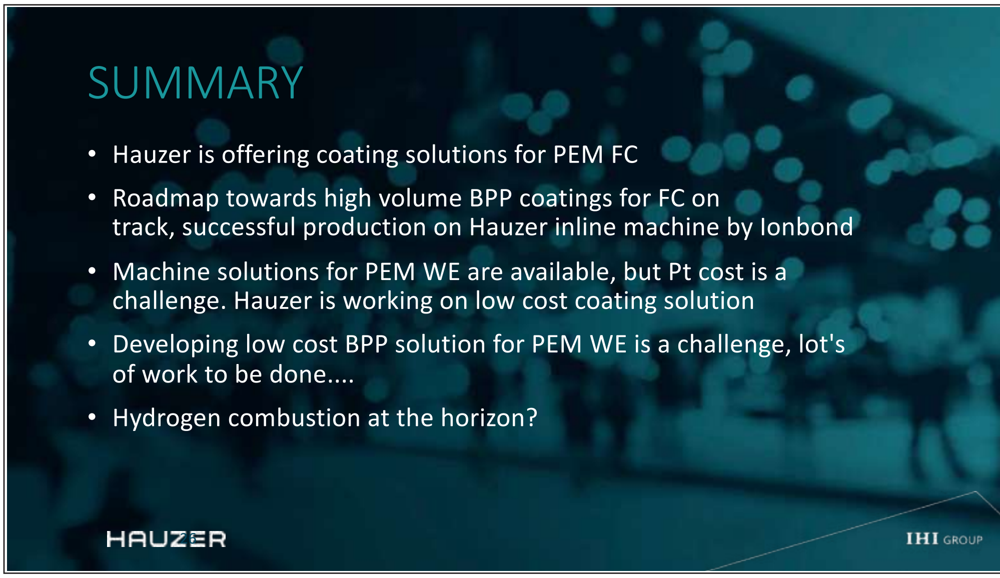
SUMMARY
• Hauzer is offering coating solutions for PEM FC
• Roadmap towards high volume BPP coatings for FC on track, successful production on Hauzer inline machine by Ionbond
• Machine solutions for PEM WE are available, but Pt cost is a challenge. Hauzer is working on low cost coating solution
• Developing low cost BPP solution for PEM WE is a challenge, lot's of work to be done....
• Hydrogen combustion at the horizon?
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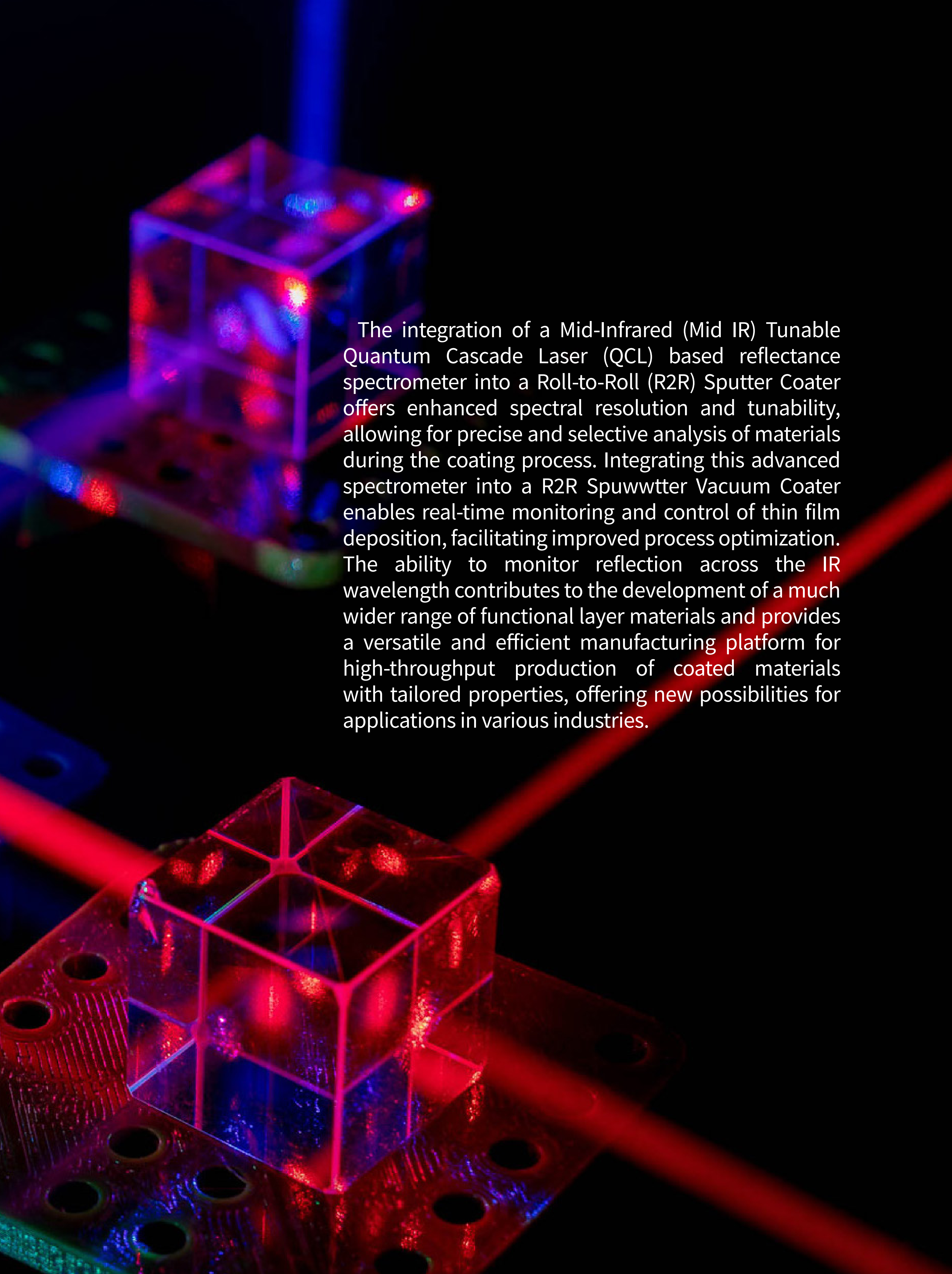
HAUZER
INDUSTRIAL PLASMA SOLUTIONS
THANK YOU FOR YOUR ATTENTION
Geert Jan Fransen
IHI Hauzer Techno Coating B.V.
IHI GROUP

CONTRIBUTED PRESENTATION
IN POWERPOINT FORMAT
FROM THE 2024 TECHCON

Adapted from a Powerpoint Presentation that was presented at the 2024 67th TechCon

Integration of a Mid IR Tunable Quantum Cascade Laser Based Reflectance Spectrometer in a Roll to Roll Sputter Coater

By Mike Simmons
Intellivation LLC., Loveland, CO



The integration of a Mid-Infrared (Mid IR) Tunable Quantum Cascade Laser (QCL) based reflectance spectrometer into a Roll-to-Roll (R2R) Sputter Coater offers enhanced spectral resolution and tunability, allowing for precise and selective analysis of materials during the coating process. Integrating this advanced spectrometer into a R2R Spuwwtter Vacuum Coater enables real-time monitoring and control of thin film deposition, facilitating improved process optimization. The ability to monitor reflection across the IR wavelength contributes to the development of a much wider range of functional layer materials and provides a versatile and efficient manufacturing platform for high-throughput production of coated materials with tailored properties, offering new possibilities for applications in various industries.

INTEGRATION OF A MID IR TUNABLE QUANTUM CASCADE LASER BASED REFLECTANCE SPECTROMETER IN A ROLL TO ROLL SPUTTER COATER

Note from Managing Editor: We are delighted to share with the readers of the Bulletin some of the interesting Powerpoint Presentations from past TechCons. We hope you find them as interesting as we do.

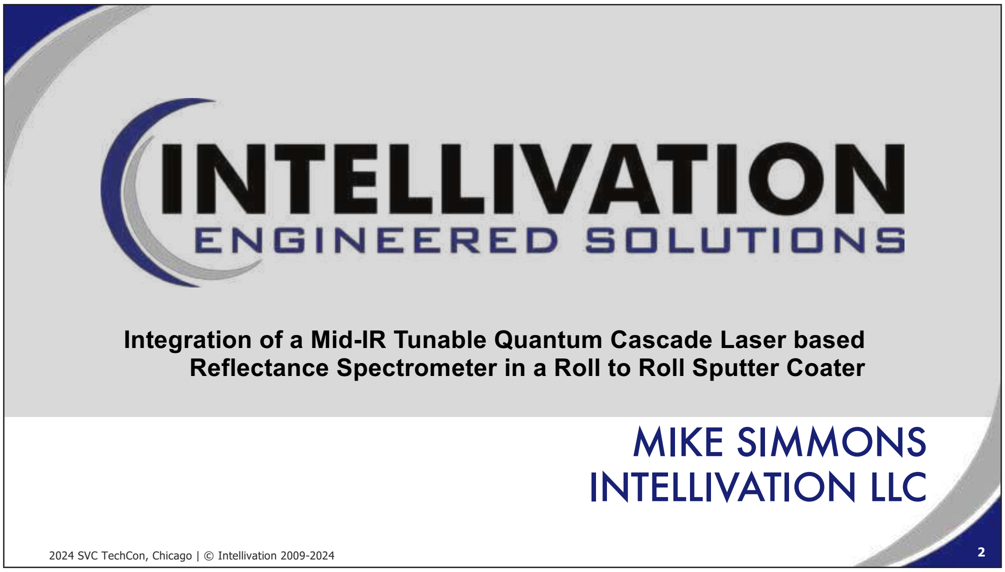
Sue Taube/Managing Editor

Integration of a Mid IR Tunable Quantum Cascade Laser Based Reflectance Spectrometer in a Roll to Roll Sputter Coater

Mike Simmons, Intellivation LLC., Loveland, CO

The integration of a Mid-Infrared (Mid IR) Tunable Quantum Cascade Laser (QCL) based reflectance spectrometer into a Roll-to-Roll (R2R) Sputter Coater offers enhanced spectral resolution and tunability, allowing for precise and selective analysis of materials during the coating process. Integrating this advanced spectrometer into a R2R Sputter Vacuum Coater enables real-time monitoring and control of thin film deposition, facilitating improved process optimization. The ability to monitor reflection across the IR wavelength contributes to the development of a much wider range of functional layer materials and provides a versatile and efficient manufacturing platform for high-throughput production of coated materials with tailored properties, offering new possibilities for applications in various industries.

https://www.svc.org
DOI: https://doi.org/10.14332/svc24.proc.0049



Company

Engineering & Process Centric Equipment Company
- Founded in 2009, Celebrated 15 years.
- Innovation Center
- Located in Loveland, Colorado, USA

Production Roll to Roll Coating Equipment
- Innovative R2R Systems up to 2 Meters Wide
- Advanced Process Technology & Monitoring Technologies
  - Reactive Sputtering Control
  - Magnetrons & Magnetics
  - Substrate Pre-Treatment
  - In-Situ Monitoring

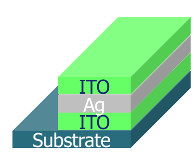
Vertically Integrated
- >50,000 ft^2 Purpose-Built Facility
- Engineering, Machining, Fabrication, Assembly and Testing

In-House Application & Development Lab
- Process & Product Development
- Technology, Component & Process Demonstration

Thin Film Development Application Lab

Intellivation Application Lab

- **Process Demonstration and Development**
  - Complex multi-layer coatings
  - Metals, oxides, nitrides, oxynitrides
- **Interchangeable Deposition Modules**
  - Single or Dual Rotatable & Planar Magnetrons
  - Power Supplies: Bipolar Pulsed DC, DC, RF, HIPIMS
- **Many Target Materials Available On Site**
- **Rapid Coating Development**
- **Intellivation Process Know-how and Support**
- **Modeling and Design of Multi-Layer Coatings**
- **In-house Characterization Lab**



In-Situ Reflectance Monitoring of UV-VIS Thin Film Optical Coatings In R2R Coater

- **Benefits of In-Situ Monitoring**
  - Decreases Process Development Time
  - Increases Production Yield
  - Rapid Materials Development
- **In-Situ UV-VIS and NIR Optical Reflectance Metrology**
  - UV-VIS and NIR Spectroscopy is routine with COTS
    - Fiberoptics
    - High Spectral Power Light Sources
    - MEMS Optical Gratings and
    - CCD/CMOS Linear Array Detectors

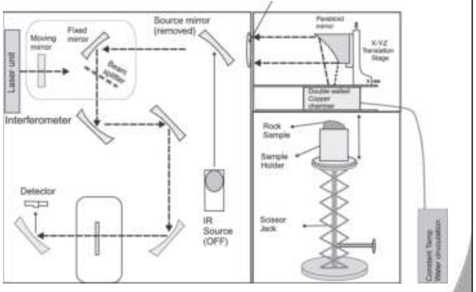
CONTRIBUTED PRESENTATION
IN POWERPOINT FORMAT
FROM THE 2024 TECHCON

INTEGRATION OF A MID IR TUNABLE QUANTUM CASCADE LASER BASED REFLECTANCE SPECTROMETER IN A ROLL TO ROLL SPUTTER COATER

In-Situ Reflectance Monitoring of Mid Infrared Thin Film Optical Coatings In R2R Coater

Mid-IR Reflectance Presents a Challenge for In-Situ Metrology

- FTIR (Fourier Transform Infra Red) Optical Benches and Light Sources are challenging to integrate into R2R production equipment
  - Physical Size
  - Heat Dissipation
- Thermal Light Sources used for this traditional optical method have very low Spectral Power Densities requiring 100s of scans and requiring integration of 10s of minutes to achieve acceptable Signal to Noise Ratio.
- **FTIR measurement time is too slow for on-line measurement**



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Benefits of Cross-Substrate In-Situ Measurement

- **Accelerates Development**
  - Real time or fast vs. vent, remove, cut, measure
- **Process Tuning and Optimization**
  - Reactive deposition process
  - Complicated multilayer coating performance
- **Incorporation into Historian System**
  - Automatic integration into the data logger on the coating tool
- **May completely eliminate the need for ex-situ measurements**
  - For well-characterized materials

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Alternative Solution
Mid-IR Spectroscopy Tunable Quantum Cascade Laser Light Sources

- **Scanning Quantum Cascade Lasers (sQCL) are Capable of Wide Tuning Ranges**
  - Ranges: 2 to 13 um
  - Spectral Power Density is 1 million times greater than thermal light sources used in FTIR measurements
- **Demonstration**
  - sQCL
  - Custom Fiber Optics for Reflection Measurement in Vacuum
  - Customized Signal Detection

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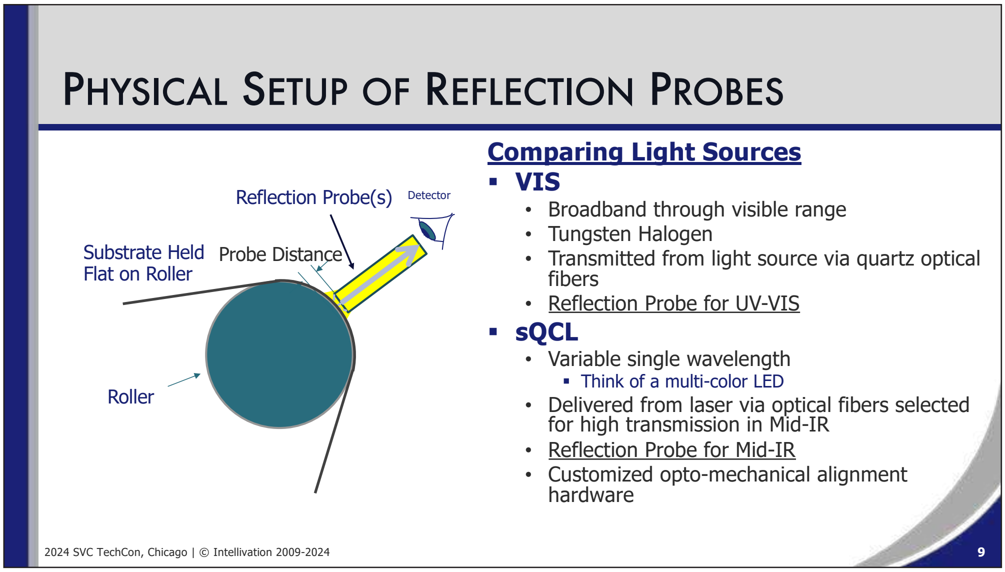

Physical Setup of Reflection Probes
Reflection Probe(s)
Detector
Substrate Held Flat on Roller
Probe Distance
Roller
Comparing Light Sources
VIS
Broadband through visible range
Tungsten Halogen
Transmitted from light source via quartz optical fibers
Reflection Probe for UV-VIS
sQCL
Variable single wavelength
Think of a multi-color LED
Delivered from laser via optical fibers selected for high transmission in Mid-IR
Reflection Probe for Mid-IR
Customized opto-mechanical alignment hardware
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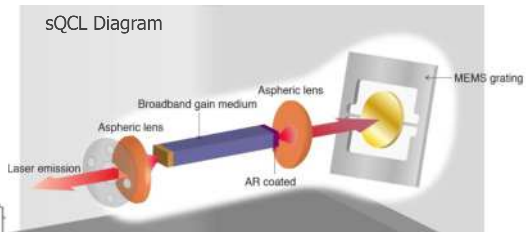
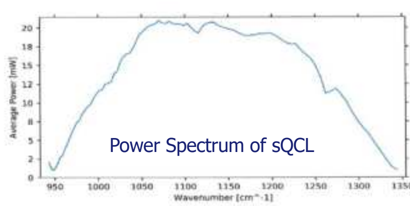
INTEGRATION OF A MID IR TUNABLE QUANTUM CASCADE LASER BASED REFLECTANCE SPECTROMETER IN A ROLL TO ROLL SPUTTER COATER

sQCL – scanning Quantum Cascade Laser

- **LASER**
  - Light Amplification by Stimulated Emission of Radiation
- **Angle of grating selects wavelengths emitted by laser**
- **The gain medium is pulse pumped by a second light source timed with grating position**
  - Light is pumped in

sQCL Diagram





- **20mW peak power**
- **Suitable detector also required**

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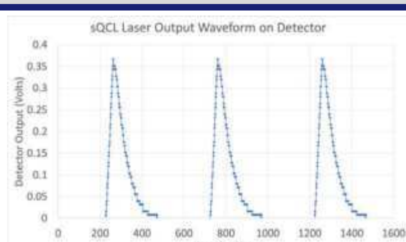
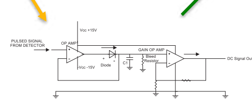
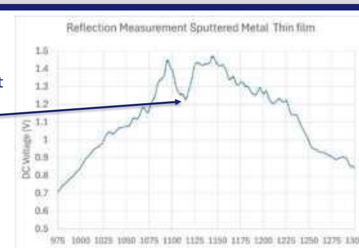
sQCL – scanning Quantum Cascade Laser



Laser Pulses at Programmable Widths and Periods At Each Wave Number giving a temporal output that is transformed to WN/time



Is this the result of a metal oxygen vibrational mode? See next slide



Spectral Response converted to DC Signal for 20 second scan

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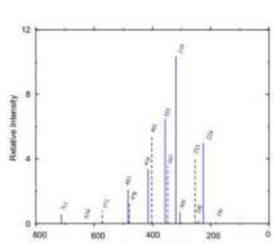
Mid-IR Spectra of Metal Oxide

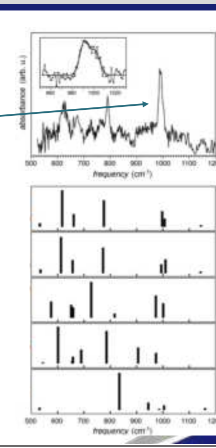
Vibrational Absorption Bands of a selected Metal Oxide



Example of a Metal Oxide with Overlap (absorption @ (1100 cm-1)

Mid-IR Spectral Region

- Can Overlap Vibrational Modes in some materials
- Review of Literature shows no expected overlap with thin film interference fringes.



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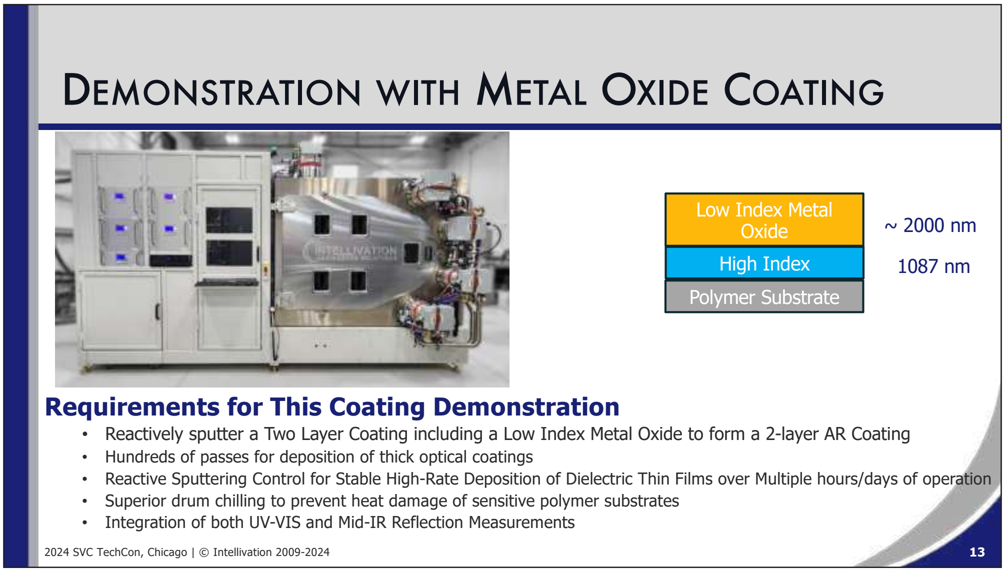
DEMONSTRATION WITH METAL OXIDE COATING
Low Index Metal Oxide
~ 2000 nm
High Index
1087 nm
Polymer Substrate
Requirements for This Coating Demonstration
• Reactively sputter a Two Layer Coating including a Low Index Metal Oxide to form a 2-layer AR Coating
• Hundreds of passes for deposition of thick optical coatings
• Reactive Sputtering Control for Stable High-Rate Deposition of Dielectric Thin Films over Multiple hours/days of operation
• Superior drum chilling to prevent heat damage of sensitive polymer substrates
• Integration of both UV-VIS and Mid-IR Reflection Measurements
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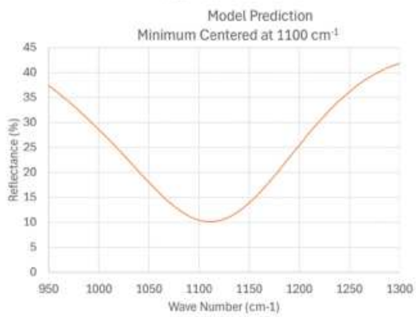
INTEGRATION OF A MID IR TUNABLE QUANTUM CASCADE LASER BASED REFLECTANCE SPECTROMETER IN A ROLL TO ROLL SPUTTER COATER

Theoretical Model



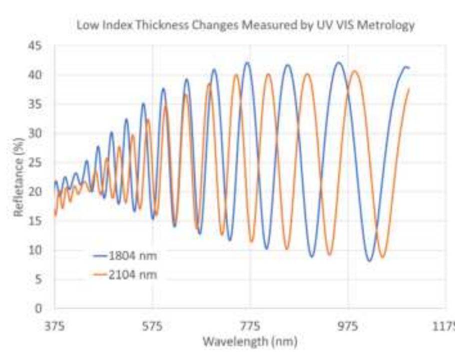
Model of 2-layer AR Coat at 1125 cm^{-1}

Prediction Assumptions

- We extrapolated Optical Dispersion to higher wavelengths from literature values
- Changes in index from model will adjust interference shape, amplitude and spectral location of the Reflectance minimum

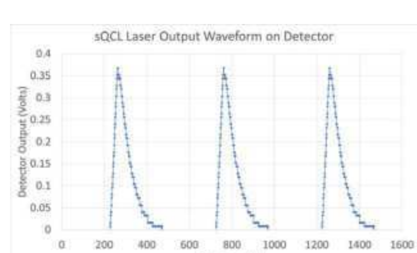
In-Situ UV-VIS to Validate Layer Thickness

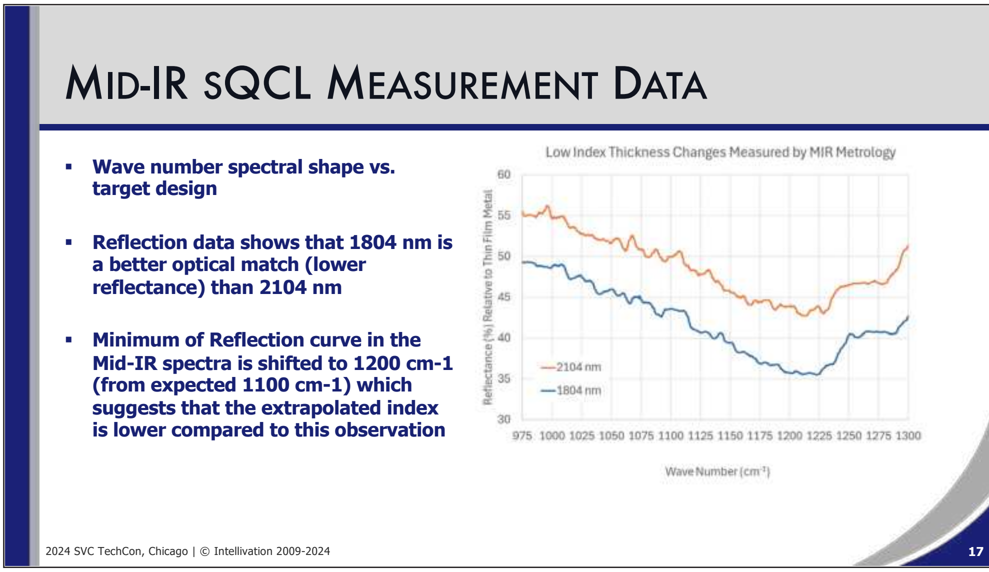
- **Two thicknesses of the metal oxide coating were deposited and reflectance measured**
- **Determined physical thickness from spectra**
  - 1804 nm and 2104 nm
- **Reflectance data alone requires good knowledge of n and k for the film**
  - The exact n and k produced by the process
- **In-Situ Transmission measurements are helpful and also possible**

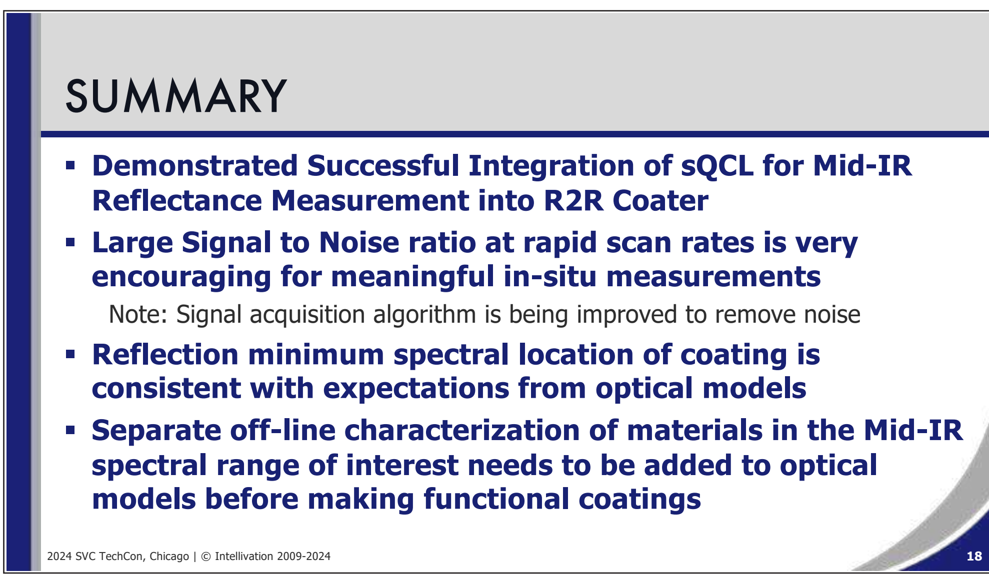


Mid-IR sQCL Measurement Data

- **sQCL emits Mid-IR pulses**
- **Detector detects reflected Mid-IR as a pulse**
- **Process that signal into wave number spectrum in order to see how the coating performed**







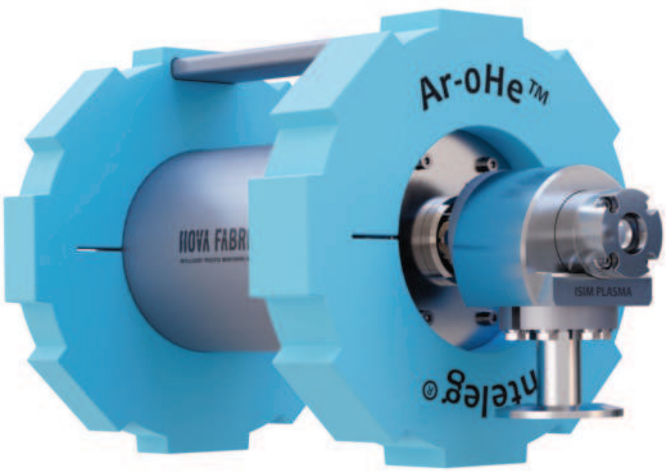
About the Author: Michael Simmons

Michael Simmons is President & CEO of Intellivation, LLC, a vacuum coating equipment manufacturer he founded in 2009. Since 2009, Intellivation has become one of the leaders in providing Roll to Roll vacuum coating systems and process support. Mike is responsible for designing, manufacturing and installing a wide variety of equipment over the past 16 years, from production vacuum deposition R2R tools to R&D systems, and automation machinery. Roll to roll vacuum deposition is the primary focus for Mike and his team, as exemplified by Intellivation's innovative R2R series product line. Mike's extensive background in plasma processing and equipment continues to be enhanced by the installation of a R2R Lab system at Intellivation which has enabled Mike and Intellivation to become vacuum process knowledge leaders in a wide range of sputtering technologies, deposition control and web handling as well as other PVD techniques. His commitment to the industry involves being a Board of Director of Society of Vacuum Coaters (SVC), an SVC Instructor for Web Coating, Chair of AIMCAL's Vacuum Web Coating Committee, RMCAVS Chair, an active member of AVS and continuous support of the vacuum community through multiple initiatives and sponsorships. Mike earned his mechanical engineering degree (BSME) from the University of Idaho where he graduated with honors, and is a licensed Professional Engineer. Mike has published multiple technical papers and presented at global conferences on Vacuum Coating Processes, including but not limited to Vacuum Technology and State of the Art Roll to Roll Equipment and Processes.

inteleg.io NOVA FABRICA

Inteleg® Ar-0He

Zero Helium. Maximum Precision.



Inteleg® Ar-0He

Leak detection by OES

Revolutionising Leak Detection

	✓ Argon-spray mode	✗ Helium-spray mode
Leak finding process	Fast	Slow
Leak location accuracy	Precise	Inaccurate
Residence time	Ar, <10s	He, approx. 30 min.
Detector use complexity	Simple	Complex
False-positives	No	Yes
Detector set cost	$	$$$
Spray gas cost	$	$$$
Spray gas type	Ar	He
Spray gas availability	Readily available	Shortage

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EXECUTIVE DIRECTOR'S MESSAGE

Frank Zimone
SVC Executive Director

Plan the work and then work the plan…

Today is September 1, 2025, an unusually lovely day here outside Philadelphia which I call home. Considering our publication schedule, the Fall-Winter Bulletin has to come together in early September and today being a holiday, it is a quiet time to reflect on the challenges ahead.

As a start, I generally look back on the sentiments that I expressed a year earlier to see "how we did." Let me share the opening two paragraphs from a year ago…

"Taking a brief glance in the rearview mirror, it can be hard to believe the progress we have made as an organization. SVC 2.0 effectively began on opening day of the 2017 TechCon in Providence, Rhode Island. The SVC Board of Directors made the decision to organize as a completely independent entity and manage all operations internally. To say we had a blank slate for future success is quite the understatement. Effectively we had a broken hard drive with fragmented archival and financial information, two contracts for future events that were not optimally negotiated, and access to a core of dedicated volunteers who were determined to see the SVC through those turbulent times. Honestly, I don't believe any of us had a good night's sleep for the first few years.

The finishing touches were just put on a 2025 budget that the SVC Board of Directors will review, modify, and approve at the end of October. We are forecasting another solid year with modest expectations on review. This drives us to conserve spending until later in the cycle where we have a better feel for participation in 2025. We will show positive cash flow in 2025 for the fourth year in a row. Few, if any, of our professional peer organizations can make this claim"

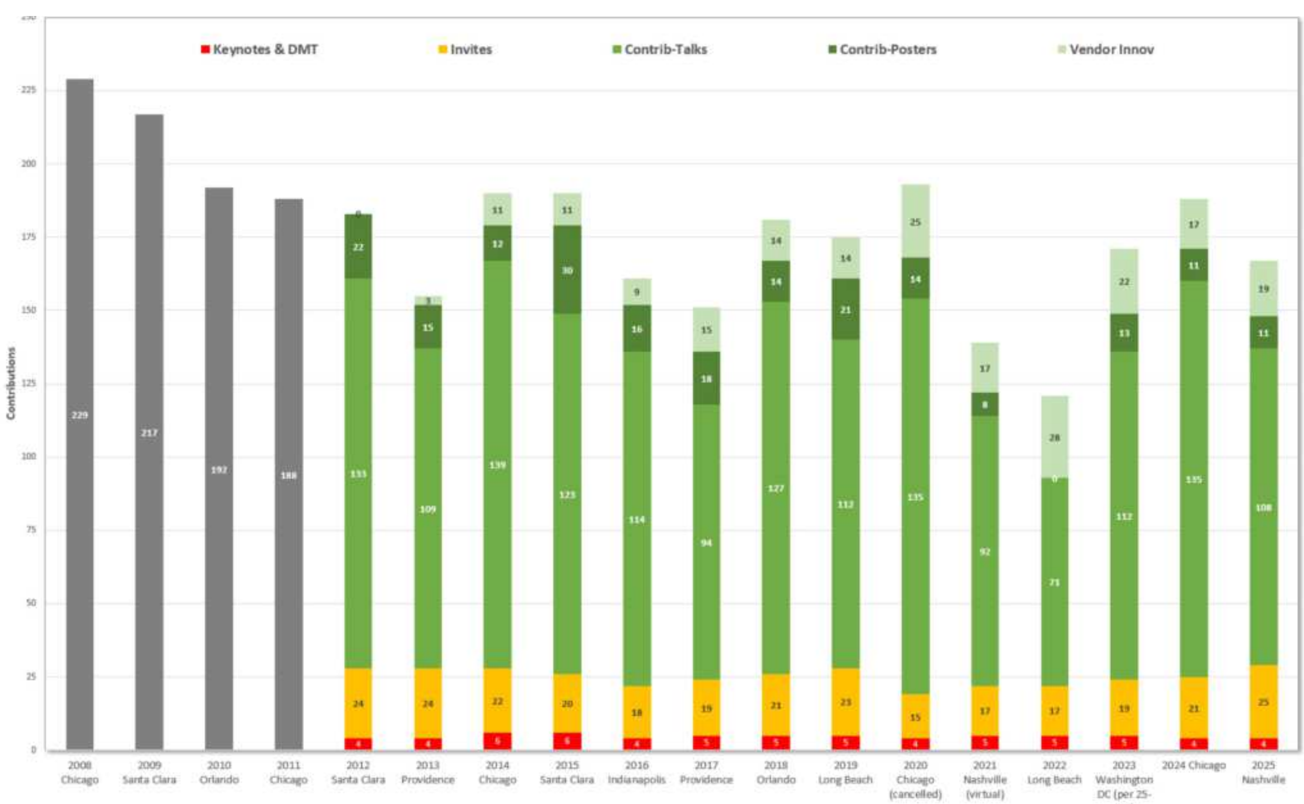
So how did we do?

The short answer is that the 2025 cycle was quite mixed when we look at any reasonable set of metrics of our performance.

Qualitatively, we received unusually high grades from our conference attendees and exhibitors on the depth, breadth, and engagement of the TechCon, Education Program, and Exhibition. Nashville was an ideal location, the venue and accommodations were absolutely first rate, and the Gaylord staff could not have been more helpful. From that perspective we exceeded expectations.

However, conference attendance was down by approximately fifteen (15) percent. Uncertainty in the business climate due to the introduction and turmoil of the rollout of the USA's new tariff policies, travel restrictions imposed on all US Government contractors, national laboratories, and research organizations and the sharp cutback in funding for our academic stakeholders all contributed to an event that did not meet planned attendance levels. Specifically, the number of "contributed abstracts" to the general technical sessions fell short. Consequently, we wound up with a significant budget shortfall for 2025.

Although we take little solace from being the "least worst" in comparison to our peer professional societies and thankfully



have more than adequate financial reserves to cover this hiccup, we are far from satisfied and complacency is not an option.

People are still and will remain to be the "secret sauce" of the SVC.

In our "world," the business model is quite simple. A robust and expansive technical conference program drives attendance. Attendance drive exhibitor participation. A busy conference and vibrant exhibition influence the success of the tutorial program. So, in essence, if the conference is strong and growing, literally every other concern and issue we have as an organization takes care of itself. This model continues to light our way forward and for 2026 we will be:

- Adding four (4) additional sessions to the TechCon along with a re-energized and reinvigorated leadership team of eighty-seven (87) passionate missionaries who are dedicated to making all 22 sessions as successful as they can be.
- Six (6) planned Colloquia sessions (in 2025 we put on two!) and afternoon "Tech Forum Sunset" networking sessions, dramatically expanding what are arguably the most popular and powerful conference events that are unique to the TechCon.
- Six (6) completely new tutorials complementing the thin film community's most expansive education program.
- Providing all TechCon exhibitors (we expect more than 110 exhibiting companies in 2026) with two free giftable tickets for the tutorial program.

The SVC Program Leadership is the engine of our collective success, identifying speakers and presenters in their specific areas of expertise. Truly, their efforts define our future and relevance in a crowded and often fragmented professional society environment! Our job at the SVC administration level is to simply find a venue that can highlight their efforts and brutally manage expenses associated with Society operations.

Take a moment to look through this issue of the Bulletin to identify and recognize the leadership that makes the SVC "who we are." But do not stop there. Say to yourself, how can I participate in this activity? What can I bring to the effort? Why shouldn't I raise my hand to assist rather than wait for someone else to? This renews our secret sauce to ensure that we are just as relevant to the SVC of tomorrow as we were to the SVC of old.

Stay safe and see you at Long Beach!

— Frank Zimone
SVC Executive Director
frank.zimone@svc.org

The SVCF Board of Directors would like to thank the following companies for their very generous sponsorship of the 19th Annual SVCF 2025 Virtual 5k Run/Walk. We are so very grateful for your support of the Foundation as we strive to make a difference in the lives of our students and technicians.

THANK YOU!

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SVC FOUNDATION NEWS

Heading back to school and looking towards Fall, I hope everyone in the northern hemisphere enjoyed a wonderful Summer. Cooler temperatures and colorful leaves on the trees we look forward to, but not necessarily the snow and cold of winter. On the other side of that thought, I hope our colleagues in the southern hemisphere are looking forward to their approaching Summer!

That said, it is time to hunker down and get back to the business of moving the Foundation forward. We are extremely appreciative of all the support that we receive from you. Our sustaining membership (those that donate monthly) is growing.

Every once in a blue moon, someone donates a vehicle to help support our educational scholarship cause. We exist to support the sharpening of our workforce and honing of their skills. But

we all need to promote the SVC and its importance in supporting our field of surface engineering. We are looking for new Board members, so if you have an interest in joining our fundraising and educational causes, please step forward!

You have probably heard that the company I founded, VTI, has been acquired by HEF based in Lyon, France and I have retired. It has been a wonderful 38 years and I'm excited for VTI's future. But I am more excited to have more time to dedicate to the SVC and our Foundation. I value what we have and hope that you do too. Please keep us in mind with your year-end giving plans.

— Kind regards,
Gary Vergason
SVC Foundation Chair

Promote – Participate - Support

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CORPORATE SPONSOR NEWS

GENCOA BUILDS ON SALES AND TECHNICAL SUPPORT OFFERING FOR USA

Gencoa offers technical sales and support to customers across the USA and recently welcomed Michael Cummins to the team, in the role of US Sales Representative.

Centered in Austin, Texas, where his business is based, Michael has lived in states throughout the country, including Washington, New York and Colorado.

He studied Economics and Anthropology and previously worked in the tech industry, helping manage financial crimes and fraud on platforms offered by Meta.

Michael's role at Gencoa Ltd will see him focus on expanding the sales presence of Gencoa Ltd in North America. Although primarily focused on his home state of Texas, Michael will offer an increased presence in the Pacific Northwest, alongside the support of established sales reps and industry partners throughout the United States.

In addition to facilitating sales and product promotion, Michael will assist in conducting on-site demonstrations of key products, including the recently-released Optix 3.0 gas sensor, and the Speedflo range of reactive process control instruments.

Of his new role, Michael said: "I find the vacuum industry to be incredibly interesting and it is my personal goal to expand this specific field of research and help assist end users with the development and manufacturing of goods, and products.

"I am here in many ways to build relationships and make connections with industry partners so we can grow the industry. I am new to this industry, but excited for the opportunity to grow with some of the brightest minds this world has to offer."

Contact details for US-based customers:
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OVER $2.5 BILLION INVESTED IN FUSION INDUSTRY IN PAST YEAR

The fusion industry raised $2.64 billion in private and public funding in the 12 months leading to July 2025, according to the annual Global Fusion Industry Report by the Fusion Industry Association (FIA). The figure marks a significant increase from 2024 and is the second highest yearly fusion funding figure since the report began, after the 2022 record year.

Now in its fifth year, the report provides a comprehensive view of the growth of the fusion sector and progress towards commercial fusion deployment. This year, 53 fusion companies responded – up from 23 in 2021 – with eight new entrants since last year.

This year's total figure includes several major funding rounds including the $900m Series A for US-based Pacific Fusion, which came out of stealth mode in November 2024. Other significant rounds included a $425m Series F for US-based Helion in January 2025, and €113m Series B for Germany-based Marvel Fusion.

Despite the acceleration in funding, 83% of respondents still consider investment a major challenge. And when asked how much more investment each company would need to bring their first pilot plants online, answers ranged from $3m to $12.5 bn, with a median response of $700m. Giving a total of $77 billion, this is eight times more than has been committed to the industry to date, though the report emphasizes that this should not be taken as the total investment needed, as there will inevitably be some consolidation, with a smaller number of market leaders emerging.

Nonetheless, fusion companies remain confident in their timelines for delivering fusion-generated electricity to the grid, with 84% of respondents believing this will happen before the end of the 2030s and 53% by 2035.

The report also highlights that backing is coming from a wide range of investors, including deep tech venture capital firms like DCVC and Breakthrough Energy Ventures; industrial giants such as Chevron, Siemens Energy, and Nucor; sovereign and quasi-public funds including In-Q-Tel, the European Innovation Council Fund, and Plynth Energy; and strategic players from the energy sector like Shell Ventures and Energy Impact Partners.

The amount of public funding invested in fusion companies also increased by 84% from last year, growing by almost $360 million to nearly $800 million in total.

More than half of the fusion energy startups in the report are based in the US (29), while a further 13 are in Europe. The remainder are operating in countries across Asia and Oceania. The survey showed fusion companies directly employ 4,607 people and support at least 9,300 supply chain jobs, though this is likely an undercount as not all companies provided employee data. Since 2021, the number of people employed directly by fusion companies has more than quadrupled.

"With a half-decade of consistent data, we can now identify clear trends that speak to both the promise and challenges of commercial fusion energy. The acceleration of capital, even when the global economy has tightened, is a signal of maturing investor confidence, technological progress, and a rapidly coalescing supply chain. The maturation of the ecosystem, and increased interest from governments via public-private partnerships show fusion is no longer a purely scientific effort; it is a global industrial movement." FIA CEO Andrew Holland

The full report can be downloaded on the FIA website.

The Fusion Industry Association (FIA)
www.fusionindustryassociation.org

KOLZER BECOMES KOLZER INTERNATIONAL: *A NEW INDUSTRIAL GROUP CONNECTING EUROPE AND THE UNITED STATES*

Kolzer Srl, a historic European manufacturer of vacuum coating systems using PVD (Physical Vapor Deposition) technology, has officially joined **Kolzer Internationa**l, a new industrial group formed in collaboration with a team of **established U.S. industry experts** in advanced manufacturing and surface technologies.

The merger, completed on **July 10, 2025**, marks a strategic industrial and commercial turning point for Kolzer. The company is now part of an international organization with operational hubs in **Milan and Minneapolis**, combining European engineering excellence with direct presence in the North American market.

"Kolzer International is not just a new name, it is a technology and business platform built to serve key markets with precision, while staying true to our technical DNA," said **Davide D'Esposito**, CEO of Kolzer Srl.

Founded in 1952, Kolzer has spent over 75 years developing advanced vacuum coating technologies, delivering high-performance, customized solutions to industries such as **automotive, fashion, electronics, cosmetics, aerospace, and luxury packaging**. With more than **1,300 systems installed worldwide**, the company is recognized as a pioneer of the **"PVD 2.0"** generation: efficient, flexible, and sustainable vacuum coating systems.

The new U.S. facility, **Kolzer International Company (KIC)**, will offer high-profile machine manufacturing, lab coating services, and local after-sales support. KIC will focus specifically on decorative and design-driven applications, working closely with American customers and partners.

Kolzer International also plans future expansion in the Asian market, with the goal of scaling global manufacturing capabilities and meeting the demands of a fast-evolving industry. Depending on project needs and logistics, machines may be manufactured in either Europe or the United States.

Kolzer International represents the evolution of a highly specialized European company into a global, scalable, and operational industrial group. It combines advanced technology with industrial reliability to lead the new generation of high-performance, sustainable surface finishing solutions.

Kolzer Srl
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