

Tuesday, May 12

10:30 a.m. IS-1 Benefits of Aluminum for the Construction of Vacuum Chambers for Use in Large Area Coating and Deposition Systems

K. Coates, J. Bothell, R. Bothell, and E. Jones, Atlas Technologies, Port Townsend, WA

The mass production of architectural glass, flat panel displays and photovoltaic panels demands ever increasing complexity and scale. Traditionally, high-vacuum coating chambers are constructed from stainless steels such as 304, 304L and 316L. The chambers become a significant component of the system budget. This paper aims to show that aluminum can be considered to have significant advantages over steel, even mild steel, as a material for chamber construction. Over and above total cost (an aluminum chamber is approximately 40% cheaper than an equivalent stainless one), aluminum 6061 alloy has multiple material and vacuum properties that provide strong incentives to produce large vacuum chambers from aluminum. Compared to stainless steel, aluminum is a much easier and quicker material to machine and manufacture from. Its lighter weight allows for easier handling and transportation. Aluminum has a high thermal conductivity that allows for the efficient bakeout of chambers and facilitates the management of process temperatures. Perhaps most importantly, the high vacuum properties of aluminum rival those of stainless steel. Outgassing is exacerbated in large chambers with significant internal surface area. It is possible to achieve outgassing rates that exceed stainless steel, in the region of 1×10^{-13} Torr $l \text{ s}^{-1} \text{ cm}^{-2}$.

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10:40 a.m. IS-2 Dry Pumps - Cost Effective “Green” Vacuum Coating Process Solutions

J. Luby, Edwards Vacuum, Tewksbury, MA

There is growing pressure on manufacturers to make “green” products, which ties into a responsibility each and every one of us has to make environmentally responsible choices. OEMs and end users alike are faced with fluctuating energy costs having a significant impact on the cost to manufacture and operate a coating tool. Companies which faced the reality of a shifting demand toward “green” products and “green” manufacturing stand ready to supply the world’s demand for high quality products with minimal environmental impact. This paper examines the shift in demand for vacuum products requiring less energy to operate, less oil to dispose of, least footprint to consume, and least cost of ownership while never compromising and perhaps improving performance and longevity. From conception to prototype to test to market, one must look for ways to make a better product for less money and less environmental impact. For many companies, this effort began long before being “green” was fashionable or even considered a phrase to be coined. Being “green” is becoming the rule and we must look at what it takes to manufacture a product but, perhaps more importantly, we must better understand the cost of the product over its lifetime to know if we are striving to be “green”.

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10:50 a.m. IS-3 Design Considerations of Precision Planetary Rotation Systems

J. Oliver, Vacuum Innovations, LLC, Pittsford, NY

Planetary rotation systems have one fundamental purpose, to improve thin-film uniformity and thickness control. The Vacuum Innovations planetary incorporates advanced design and performance features while maintaining a focus on reliability and ease of maintenance. The resulting design requirements are far-reaching, from careful tolerancing of flatness and height, integrated mounts for fixed-position uniformity masks, and integrated multi-point crystal monitoring. We carefully characterize the impact of different gear ratios, source locations, and planet sizes. By modeling the influence of each of these characteristics on the overall performance of the system, we are able to achieve far more stable control and uniform coatings. We provide uniformity masks customized to individual system geometry for optimal performance and refine the designs based on a given deposition process, to compensate for the influence of gas partial pressures, source materials, and electron-beam sweep patterns. Even large-diameter substrates can be coated with less than 0.25% film non-uniformity.

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11:00 a.m. IS-4 Successful Application of Varian, Inc.'s Unique Remote Assist™ Program for Large Turbomolecular Pumps Used in Vacuum Coating Systems

T.C. Forbes, Varian, Inc., Lexington, MA

Varian, Inc. has successfully deployed its latest innovation in customer service products on vacuum coaters worldwide: the Remote Assist customer support program. Unique in the industry, Remote Assist™ is a proactive program that is specifically designed to provide first-class support in monitoring and servicing Varian turbo pumps by combining Varian's remote Monitorr diagnostic system, extended warranty, and Varian, Inc's advanced exchange program. This allows for maximum up-time and system availability. This Innovators Showcase Power Point presentation will describe the Remote Assist program and its implementation on coaters using Varian's large turbo pumps around the world.

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11:10 a.m. IS-5 Industrial HiPIMS-Bias Power Supplies

G. Eichenhofer, Solvix SA, Villaz-St. Pierre, Switzerland

High Power Impulse Magnetron Sputtering (HiPIMS) offers the ability to apply new and already existing thin film materials with advanced film properties, on standard coating machines. To deposit these state-of-the-art thin films to a structured surface, a functional substrate bias voltage system is a basic necessity. Due to the high density plasma and the high ionization rate, it is a “must” that the applied bias voltage is present on the substrate during the short HiPIMS-impulses, when peak power densities of kW/cm² are present. It can be experienced with conventional bias power supplies, that the bias voltage drops dramatically (or even vanishes) during the few microsecond lasting HiPIMS-impulses. This is well known. But there seems to be a lack of industrial available and reliable power supplies to handle this condition. Based on its already proven Magix bias PS technology with the “patented tapless wide output load impedance range”, Solvix has developed such a bias-power-system with a highly sophisticated arc-management. This new Solvix DC and DC-pulse HiPIMS bias-supply can be applicable for all the conventional techniques such as a magnetron-sputtering, arc-evaporation, pre-clean and ion-etching. Plus, it has the capability of handling all the requirements needed for the HiPIMS-impulses.

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11:20 a.m. IS-6 Recent Innovations in *In Situ* Optical Monitoring

S. Hicks, Intellevation Ltd., Glasgow, United Kingdom

In situ optical monitoring is rapidly becoming a crucial technology in the manufacturing of complex high precision optical coatings. Recent hardware and software based technological advances in optical monitoring will be presented. The first of these is real-time refractive index compensation during the coating process. This is especially useful when depositing TiO₂ layers which can experience significant run-to-run refractive index variation due to the different oxide states achievable. Achieving a fast and accurate measurement of the actual refractive index during the coating run, and then accurately correcting the cut points for all of the subsequent layers leads to enhanced process yield and product performance. Other developments include extension of monitoring wavelength regimes down into the UV and out into the IR, new test glass changer configurations for different chamber geometries and new remote support and monitoring capabilities.

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11:30 a.m. IS-7 Current and Future Development of Arbitrary Voltage Waveform Pulsed Plasma Generators

R. Chisyakov and B. Abraham, Zond Inc./Zpuser, LLC, Mansfield, MA

A unipolar arbitrary voltage wave form pulsed plasma generator (Zpuser) was introduced as a new development in pulsed DC technology for material processing applications. When used for magnetron sputtering applications, the Zpuser output voltage pulse shape typically has two voltage stages that create both low power and high power magnetron discharges within a single pulse. The high power magnetron discharge stage generates a high intensity flux of ionized sputtered target material atoms. By adjusting voltage rise time and voltage oscillation amplitude within single pulse, a stable high density plasma discharge with low energy metal ions at a high deposition rate can be created for both reactive and non-reactive processes. Zpusers can also be used for cathodic arc deposition to improve the ionization level and control the size of macro particles. The principles of operation of the Zpuser as well as the method of programming an arbitrary voltage pulse shape will be discussed. Integration of Zpusers into PVD tools for industrial applications will also be discussed. A road map for integrating Zpuser plasma generators into PVD, CVD and RIE applications will be presented.

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11:40 a.m. IS-8 COPRA 300-Radio Frequency Plasma Source for Enhancement to Existing PVD Coaters

W. Schwärzler and M. Kessler, Provac AG, Balzers, Principality of Liechtenstein; and D. Gary, Ricmar Sales and Service Inc., Aptos, CA

Provac AG introduces the industry's first stand alone RF Plasma Source enabling vacuum coaters to easily upgrade their existing PVD systems (chambers from 650 mm/25" to 1100 mm/43"). Based on the well established and proven Taurion Series RF-PEPVD technology, the COPRA 300 consists of an RF Plasma Source and portable workstation module containing laptop PC, control system, mass flow controller, power generator, and connection lines. By upgrading your existing coater or replacing the current ion source, the COPRA 300 enables the production of densified oxide layers (SiO_2 , TiO_2 , Ta_2O_5 , Nb_2O_5 , and more), shift free layers (filters), and nitrate layers. Additionally, you can plasma etch, cleanse and degas substrate surfaces in a free environment. The COPRA 300 is very simple to integrate and operate, 400+ hours of operation without maintenance; consisting of a cloth wipe down and possible extraction grid replacement, enables use of the basically neutral plasma generated from the high-frequency plasma source eliminating potential damage to the substrates by electrical discharges, and provides very high long term stability. Additionally, the use of pure process gasses (i.e. oxygen and argon) expands new areas of applications, where other processes are not suitable.

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11:50 a.m. IS-9 Optimized Magnetic Designs for Rotatable Magnetron Technology

V. Bellido-Gonzales, M. Holik, and D. Monaghan, Gencoa Ltd., Liverpool, United Kingdom (Presented by S. Williams, Gencoa LTD., San Francisco, CA)

Magnetron sputter cathodes, with rotating tubes as the target, eliminate several of the problems associated with planar magnetrons. However, there is still a need to optimize performance via the magnetic circuit that confines the plasma. A range of different magnetic types will be illustrated that can improve film uniformity, TCO conductivity, plasma stability as well as the deposition rate and energy consumption.