Monday, May 11

9:30 a.m. E-1 Photocatalytic Thin Films for Biomedical Applications

P.M. Martin, Columbia Basin Thin Film Solutions LLC, Kennewick, WA; W.D. Bennett, Pacific Northwest National Laboratory, Richland, WA; B.F. Monzyk, Battelle Memorial Institute, Columbus, OH; K.A. Dasse, Levitronix, Waltham, MA; and R.J. Gilbert, MIT, Boston, MA

Invited 40 min. Talk

Applications for thin films in biomedical applications are rapidly increasing. The photolytic artificial lung device being developed by Battelle Memorial Institute and Levitronix employs thin film photocatalytic materials, transparent conductive coatings, optical coatings and thin film membranes in a micromachined capillary structure. Progress toward the development of a photolytic artificial lung will be presented. The photolytic artificial lung is being developed to generate oxygen from water in blood using an ultraviolet light source in the presence of a catalytic surface. The basic structure consists of blood flow capillaries lined with a UV waveguide with an antireflection coating on the incident side to maximize photon transmission and quantum efficiency, a transparent conductive electrode, a microporous photocatalytic anatase titanium dioxide (2 - 5 mm thick), and a magnesium oxide coating in contact with the blood, all deposited by reactive magnetron sputtering. Blood flowed over the coated side and oxygen exchange occurred at the magnesium oxide interface 0.354 nm UV radiation was incident on the silica/indium tin oxide side. Electron-hole pairs were generated in the titanium layer by the laser radiation, which catalyzed a redox reaction with water in the blood. The MnO_2 was also used as a catalyst to dissolve oxygen in the blood. This unique approach could obviate the need for exogenous gas, possibly reduce the blood-contact surface area and allow longer periods of patient support.

Monday, May 11

10:10 a.m. E-2 Comparison of Ion Trap and Quadrupole Sensors for Mass Spectrometry

G.A. Brucker, Brooks Automation, Inc., Longmont, CO

High vacuum partial pressure measurements using a novel ion trap based mass spectrometer sensor will be demonstrated. The details of the ion trap sensor, physical construction, excitation requirements and performance characteristics will be discussed, and compared to traditional quadrupole based mass filter sensor technology. Typical ion trap data will be presented for key performance metrics and used to illustrate the potential of this novel technology. Based upon a comparative analysis against quadrupole mass spectrometers, typical applications for the ion trap sensor will be described.

Monday, May 11

10:30 a.m. E-3 Effect of Growth Conditions on the Structure Stability, Transport and Magnetic Properties of Co Doped TiO_2 Films

B. Ali, University of Delware, Newark, DE; A.K. Rumaiz, Brookhaven National Laboratory, Upton, NY; and A. Ozbay, E.R. Nowak, and S.I. Shah, University of Delware, Newark, DE

Dilute magnetic semiconductors (DMS) are considered potential materials for spintronics devices. Although there is a controversy on the origin of the magnetism in DMS, there is some consensus on the role of oxygen vacancies in deriving the ferromagnetism (FM). In the present work pulsed laser deposited (PLD) thin films of cobalt doped TiO_2 on silicon and quartz substrates are investigated. Various oxygen partial pressures (PO_2) ranging from 6.6 mPa to 53 Pa are used during the deposition for the purpose of controlling the oxygen content in the samples. Crystal structure and transport/ magnetic properties of $CoxTi_{1-x}O_2$ (x= 0.01, x=0.03, x =0.06) thin films are found to have a strong dependence on oxygen stoichiometry. X-ray diffraction (XRD) data revealed the presence of mixed phase material containing both anatase and rutile. However, the stability of each phase depends on the PO_2 present in the chamber during the growth of the films. The enhancement in electrical conductivity and magnetization is attributed to the off stoichiometric oxygen (oxygen vacancies). The activation energies obtained from the resistivity data fit to a simple thermal activation model are 20 to 140 meV. The experimental values of the activation energies are in a good agreement with the calculated values (~167 meV) for the binding energy of an electron bound to a defect site. Bound magnetic polaron model is adopted to explain the observed magnetic behavior of the samples.

Monday, May 11

10:50 a.m. E-6 Microwave Plasma-Assisted Chemical Vapor Deposition Homoepitaxial Synthesis of Single Crystalline Diamond

T. Schuelke, M. Yaran, D. King, and M. Becker, Fraunhofer USA, East Lansing, MI; and J. Asmussen, T. Grotjohn, and D. Reinhard, Michigan State University, East Lansing, MI

The mechanical, optical, chemical, thermal and electronic properties of diamond materials make it a desirable candidate for many applications, which includes, for example, high power and high frequency electronics. For electronic applications relevant diamond properties such as the band gap, saturated electron drift velocity, electric breakdown field strength and thermal conductivity exceed those of semiconductors such as silicon, silicon carbide, gallium nitride and gallium arsenide. Recent progress in the area of homoepitaxial synthesis of single crystalline diamond demonstrated material synthesis rates exceeding 50 microns per hour. This level of deposition rate may prove enabling for various diamond applications from a cost standpoint. The paper presents current results on the high rate homoepitaxial synthesis of single crystalline diamond including the simultaneous synthesis of 70 crystals.

Monday, May 11

11:10 a.m. E-5 Highly Insulating Al_2O_3, SiO_2 and Si_3N_4 Films for Sensor Applications Deposited by Reactive Pulse Magnetron Sputtering

P. Frach, H. Bartzsch, and D. Gloess, Fraunhofer Institute for Electron Beam and Plasma Technology FEP, Dresden, Germany; M. Gittner, Technische Universität IFE, Dresden, Germany; E. Schultheiss, Technische Universität IFE, Dresden, Germany and Fraunhofer FEP, Dresden, Germany; W. Brode, Siegert TFT GmbH, Hermsdorf, Germany; and J. Hartung, VON ARDENNE Anlagentechnik GmbH, Dresden, Germany

Applications in sensor, automotive and aviation technology require thin films that exhibit electrical insulating properties at room temperature but also at elevated temperatures. One technology for the deposition of such films is reactive pulse magnetron sputtering. Because of the high deposition rate this technology is especially interesting for the deposition of thick insulating films of several microns allowing high insulation voltages up to 800V or deposition onto relatively rough substrates e.g. stainless steel. In this paper the breakdown field strength and resistivity of such sputter deposited Al_2O_3, SiO_2 and Si_3N_4 films are investigated in the temperature range between room temperature and 400˚C. All investigated films show excellent insulation properties at room temperature. At high temperatures, films remain insulating but leakage currents are increasing. The level of leakage currents is higher for Al_2O_3 than for SiO_2. The combination of different film materials allows fulfilling the requirements not only on insulating but also on thermo mechanical properties. Langmuir probe, stress and XRD measurements are used to discuss the results. One example of industrial application is the deposition of electrical insulation films onto the membranes of pressure sensors using cluster type sputter equipment.