Vacuum Technology
Room 303D - Session VT-WeM
Contamination Control, Outgassing and Modeling
Moderator: T. Gessert, National Renewable Energy Laboratory

8:20am **VT-WeM1 Ultra Cleaning Techniques and Their Use in Vacuum Technology***, **P.H. LaMarche**,* Princeton University **INVITED**

A number of conditions have come together over the last ten years that have significantly advanced the state of the art in cleaning technology. The semiconductor industry has reduced feature size to the sub-100-nanometer scale, ultra-low particle counting techniques have pushed the boundaries of cleanliness for low backgrounds, and emissions regulations have become very stringent. These and other circumstances have conspired to drive substantial changes in cleaning technology, equipment, and the industries involved. In this talk, we shall examine the changes in cleanliness requirements, the concomitant changes in cleaning technology and how these changes benefit vacuum technology and those technologies that are of importance to the members of the AVS.

9:40am **VT-WeM5 Contamination Control in PECVD Processes***, **B. Shin**, Y. Uritsky,* Applied Materials*; T. Gessert, J.P. Benner,* National Renewable Energy Laboratory*; R. Childers, H.S. Ryu,* Hynix **INVITED**

The semiconductor industry is presently migrating chip manufacturing toward the sub-100-nm technology node, which is like splitting a strand of hair more than 1,000 times. Typically, more than 350 process steps are involved in fabricating these wafers, including depositions of oxides and nitrides by plasma-enhanced (PE) CVD, plasma etching steps, and final passivation. In this paper, we will examine the industry requirements on contamination control while optimizing process capability, throughput, and overall production efficiencies. The paper will also discuss how process integration and production automation are enabled by technologies involving in-situ cleaning and in-situ particle monitoring incorporated into the production tools, achieving enhanced process stability and production efficiency.

10:40am **VT-WeM8 Pressure Compensation for a Radiation-Induced Current Caused in a Vacuum Gauge Cable in the SPring-8 Storage Ring***, **T. Magome**, H. Saeki,* Japan Synchrotron Radiation Research Institute, Japan

Several hot-cathode-ionization gauges (B-A gauges) located near photon absorbers, have been under a radiation environment with a dose rate less than 1.8x10@super 2@Gy@sub air@/Ahr in the SPring-8 storage ring. A pressure-measurement error caused by a radiation-induced current in a collector cable, has been observed as a low-pressure indication in this environment. To find an actual pressure, such a pressure-measurement error in the collector cable was compensated using a radiation-induced current measured with a reference cable. As the result, the compensated pressure showed the actual pressure with a ±24% error in the pressure range from 10@super -9@Pa to 10@super -8@Pa in a stored-electron-beam condition. Furthermore a new cancellation method using a single signal cable will be tested in near future.

11:00am **VT-WeM9 Development of Horizontal NEG Coating Cathode for Long Accelerator Beam Tubes***, **D. Weiss**, H.C. Hseuh, R. Todd, P. He,* Brookhaven National Laboratory

The Relativistic Heavy Ion Collider (RHIC) at Brookhaven National Laboratory (BNL) is a superconducting heavy ion collider with two rings of 3.8 km circumference for high energy and nuclear physics research. As ion beam intensity increases so do pressure rises at RHIC room temperature ultrahigh vacuum (UHV) regions that limit further intensity gains. The pressure rises are associated with electron multi-pacting, electron stimulated desorption and ion desorption. NEG coated beam pipes have been proven effective to combat pressure rises in synchrotron radiation facilities and will be added to a significant portion of the UHV room temperature regions of RHIC. Standard stainless steel RHIC beam pipes have been NEG coated by vendors. Some special beam pipe assemblies in the RHIC experimental regions are made of beryllium and will be NEG coated at BNL. A NEG coating cathode, similar to the cathode in the low cost high yield cylindrical magnetron sputtering system developed by BNL for titanium nitride coating, has been developed to coat these special beam pipes. This cathode can accommodate chambers with lengths up to 4 meters. This system features a hollow, liquid cooled cathode that can achieve continuous sputter rates of several amps per meter. The stiffness and support of the cathode allows chambers to be coated in a horizontal position. The cathode comprises a hollow titanium tube partially covered with zirconium and vanadium ribbons. The ribbons are arranged to provide a uniform sputtering distribution and results in an acceptable NEG mixture deposited on the substrate. Vacuum performance of the NEG coated pipes was measured and coating properties analyzed with auger electron spectroscopy and scanning electron microscopy. The system design, development, and analysis results are presented.

11:40am **VT-WeM11 Slip Fluid Model of a Holweck Vacuum Pump in the Viscous and Transition Regime***, **S. Giors**,* Varian S.p.A., Italy*; F. Subba, R. Zanino,* Dipartimento di Energetica, Italy

Computational Fluid Dynamics (CFD) is playing an increasingly important role in the study of rarefied internal flows in vacuum pumps. Holweck pumps are used as high pressure stages in modern hybrid turbomolecular vacuum pumps, to extend the maximum compression ratio up to outlet pressures in the 1-10 mbar range, corresponding to the transition and the viscous laminar regime, for the typical pump's dimensions. The study of Holweck pump stages in the viscous regime has been carried out by Boulon et. al.@footnote 1@, using a no-slip fluid model. They show a good level of agreement with experimental data, but the accuracy of their model decreased for pressures corresponding to Knudsen number Kn>0.01. They suggest the need of slip boundary conditions to improve the accuracy of the model. In this work a three-dimensional model for the Holweck pump, based on the Navier-Stokes equations, with viscous slip and thermal jump boundary conditions is developed and a commercial CFD code is used to solve it in an outlet pressure range corresponding to the viscous laminar regime and transition to molecular flow for an experimental pump. The validation against the experimental data shows a good level of accuracy in terms of both compression ratio and dissipated mechanical power, up to Knudsen number Kn=0.1. @FootnoteText@ @footnote 1@ O. Boulon, R. Mathes, "Flow modeling of a Holweck pump stage in the viscous regime", Vacuum 60, 73-83 (2001).

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