Wednesday Morning, November 5, 2003

Vacuum Technology
Room 323 - Session VT-WeM

Dynamic Vacuum Systems

Moderator: L.A. Smart, Brookhaven National Laboratory

8:40am **VT-WeM2 Is Mass 19 in the Residual Gas of Very High Vacuum just F@super +@?***, **C.R. Cole**, R.A. Outlaw, R.L. Champion, B.C. Holloway,* The College of William and Mary

Typically, the mass spectral peak observed at 19 amu in residual gas analyzers at very high vacuum has been solely attributed to fluorine. Using Fourier Transform Mass Spectrometry (FTMS), the presence of the hydronium ion, H@sub 3@O@super +@,has been fully resolved from F@super +@ and shown to be quite prevalent. Analysis is presented that shows that there is ample time for the formation of the hydronium ion through ion-molecule interactions and a direct correlation to the partial pressure of H@sub 2@O. The formation time and its correspondence to ionization, trap and resonance sequences have been characterized, as well as the gas collision formation mechanisms. Additionally, the generation of hydronium was further confirmed with D@sub 2@O experiments. Formation of D@sub 3@O@super +@ in a conventional quadrupole mass spectrometer has also been observed. Gas phase formation mechanisms of hydronium and deuteronium and other formation avenues, such as ESD, are discussed.

9:00am **VT-WeM3 Quartz Capillary Gas Flow Meters***, **R.F. Berg**,* National Institute of Standards and Technology **INVITED**

The flow rate of a gas through a laminar flow impedance can be inferred from the pressures at the entrance and exit of the impedance. If the hydrodynamic model of the meter is well understood, one calibration allows such a meter to be used over a wide range of pressures and flow rates and for a wide variety of gases. The calibration is required to determine the impedance's effective geometry. This talk describes measurements on five gases with a laminar flow meter whose impedances were constructed from quartz capillary manufactured for gas chromatography. The meter is presently used as a transfer standard for flows from 1 to 1000 micromol/s (about 1 to 1000 sccm). Two additional uses are discussed. The first use relies on the circularity and uniformity of the capillary's cross-section. A determination of the average capillary radius by weighing (sensitive to radius^2) will be close to the effective radius for flow (sensitive to radius^4). This would allow the meter to be used as a primary flow standard. The second use is for gas flow measurements for primary vacuum standards. This requires extending the model to handle exit pressures less than 100 Pa.

10:00am **VT-WeM6 Development of a Low Cost Cylindrical Magnetron for Coating Long Vacuum Vessels****, P. He, H.C. Hseuh, M. Mapes, **R. Todd**, D. Weiss,* Brookhaven National Laboratory

The 2 MW US Spallation Neutron Source (SNS) includes a 248m accumulator ring that requires a 100 nm coating of TiN to reduce the secondary electron yield (SEY) of the vacuum chamber walls. Brookhaven National Laboratory (BNL) has developed a low cost cylindrical magnetron target capable of coating the wide variety of chamber geometries found in the SNS accumulator ring. Production chambers with lengths of 5m and diameters of 29cm have been successfully coated. This target is capable of reactive sputtering through the use of a gas introduction tube, and can easily be adapted for a wide variety of lengths. The magnetic field is such that primary electron trapping is longitudinally uniform, which results in excellent discharge characteristics. This method has also been used to successfully coat a Cu/TiN multilayer on production ceramic injection kicker pipes of SNS. Coating properties were analyzed with auger electron spectroscopy and scanning electron microscopy, and will be presented herein. Special emphasis will be given to the various coating configurations of production chambers and equipment used. *Work performed under Contract Number DE-AC05-00OR22725 with the auspicious of the U.S. Department of Energy.

10:20am **VT-WeM7 Advanced Closed Loop Control Method and Sensor for a Reactive Sputtering Drum Coater***, **M.A. George**, E.A. Craves,* Deposition Sciences, Inc.*; R. Shehab, K. Knox,* Ametek, Inc.

The reactive sputtering process is characterized by a hysteresis of reactive gas concentration and reactive gas flow.@footnote 1,2@ The precise control of the reactive sputtering process requires operating at a points on the hysteresis that ensures the desired high sputter flux and deposited thin film stoichiometry. The hysteresis is highly non-linear in these preferred operating regimes. The practical challenge of meeting this in the batch coating system requires a control system that can compensate for changes in reaction rate for various sputtered metals, system pumping speed changing with thermal variations and dynamic compensation of detrimental periodic cathode arcs. Closed loop control algorithms that rapidly bring the reactive sputtering system to the desired hysteresis steady state operating point are desired for multi-layer applications such as thin film interference filters that require many target starts (and stops). Conventional methods of starting the reactive sputtering process such as temporally ramping target power, voltage or current and target shutters are undesirable for precision thin film interference filters We will present control system hardware and closed loop control algorithms that permit the achievement of steady state operating points in less than 500 milliseconds on several different reactive sputtering drum coaters. The key feature of the hardware and control algorithms employed on these drum coaters is the determinism required for successful operation. We will discuss the reactive gas sensor and the algorithms employed for ensuring a temporally accurate signal of reactive gas concentration and the closed loop control method using this signal as an integral part of the loop. @FootnoteText@ @footnote 1@S. Schiller, U. Hesig, G. Beister, K. Steinfelder, J. Strumpfel, Chr. Kondorfer, and W. Sieber, Thin Solid Films, 118(1984), pp 255-270. @footnote 2@J. Affinito and R.R. Parsons, J. Vac. Sci. Technol. A, Vol. 2, No. 3, pp 1275-1284.

10:40am **VT-WeM8 The TRASCO-ADS Project Windowless Interface: Theoretical and Experimental Evaluation***, **P. Michelato**, D. Barni, D. Sertore,* INFN - Lab. LASA, Italy*; A. Colaiuda, P. Turroni,* ENEA Centro Ricerche di Bologna, Italy*; G. Bertacci,* ENEA Brasimone, Italy*; A. Bonucci, R. Giannantonio, M. Urbano,* SAES Getters, Italy*; L. Cinotti,* ANSALDO, Italy

TRASCO-ADS, the Italian acronym for Transmutation TRASmutazione) of nuclear Waste (SCOrie), is a national funded program in which INFN, ENEA and Italian industries work on the design of an accelerator-driven sub critical system (ADS) for nuclear waste transmutation. One of the most critical aspects of an ADS is the interface between the UHV environment of the accelerator and the pressurized system of the spallation target (400Â°C Pb-Bi eutectic or pure Pb at about 1 bar), due to thermomechanical issues and to radioprotection and safety constraints. Two interface concept designs have been evaluated. In a first case, a thin window physically separates the high pressure and the low pressure sides of the interface. In a second case (windowless), the linac and the spallation target are separated only by means of a suitable pumping system. This paper reports a description of the whole machine based on the windowless solution, an evaluation of the gas and vapour loads evolved from the hot interface region and the preliminary results drawn from numerical models developed to describe the flow of said vapours and gases inside the complex geometry of the interface. We here discuss about the experimental validation of the above models, carried out through suitably developed experimental devices. A first order design of the vacuum system is also proposed.

Author Index

Bold page numbers indicate presenter