Thursday Morning, October 18, 2007

Vacuum Technology

Room: 618 - Session VT-ThM

Pumping, Pressure Measurement and Calibration

Moderator: J. Luby, BOC Edwards

8:00am **VT-ThM1 Review of Seven Years Field Application Experience of an EPX Single Mechanism for High Vacuum Pumping**, ***A.D. Chew***, *C. Shaw*, BOC Edwards, UK **INVITED**

A single dry pump mechanism capable of reaching high vacuum and itself exhausting to atmospheric pressure has been a "vacuum-technology panacea". The development and deployment of a single-shaft, high-speed EPX pump isince has gone some considerable way to achieving this goal. This paper will describe the stages in the development history and expanding applications the pumps has been applied to. This will be further illustrated by specific applications examples, reliability and economic experiences.

8:40am **VT-ThM3 How to Efficiently Combine Ion Pumps and Getter-Palladium Thin Films**, ***C. Paolini***, *M. Mura, F. Ravelli*, Varian S.p.A., Italy

Non-evaporable getters (NEG) have been extensively studied in the last years for their sorption properties towards many gases. In particular, an innovative alloy produced in the form of thin films by magnetron sputtering was developed and characterized at the European Center of Nuclear Research (CERN). It is composed of Ti-Zr-V and protected by an overlayer of palladium (Pd), according to a technology for which we got the license. The use of NEG-Pd thin films in combination with ion getter pumps allows to obtain a simple and easy to handle pumping device for UHV and XHV applications. In order to show how it is possible to apply this coating technology to the internal surface of different types of ion pumps, several tests were carried out on pumps of various shape, size (in terms of nominal pumping speed) and type (diode, noble diode and triode). A special care was taken during the thermal cycle of bakeout and activation of the pumps, in order to preserve the internal film from the contamination due to the sputtering of the cathodes and/or from the interdiffusion of its components. Some important remarks about the most appropriate conditions of pressure and temperature will be discussed. The performances of the NEG-Pd coated ion pumps were evaluated in terms of ultimate pressure, nitrogen and hydrogen pumping speed. The contribution of the thin film is particularly relevant for the pumping of this last gas, due to its high sticking factor for palladium and to the great sorption capacity of the underlying getter. Finally, the possibility of further improvement of the performances by substituting the palladium with other Pd-based alloys will also be evaluated.

9:20am **VT-ThM5 Vacuum Improvements and Characterizations for the Jefferson Lab Polarized Electron Source**, ***M.L. Stutzman***, *P.A. Adderley, J. Grames, M. Poelker*, Thomas Jefferson National Accelerator Facility

Improving vacuum is a necessary step toward improving photocathode lifetime in DC high voltage polarized electron sources, which is an important goal for both the CEBAF nuclear physics accelerator at Jefferson Lab and future facilities. A new load-locked photogun vacuum system has been constructed using many vacuum improvements, including vacuum firing and NEG coating the gun high voltage chamber. The vacuum characteristics of the new photogun are described in the context of traditional vacuum measurements but perhaps more importantly, a vacuum assessment is made by comparing new and old photogun performance.

9:40am **VT-ThM6 Theory and Design of a Pirani-style Thermal Conductivity Vacuum Gauge with Unique Geometries and Control Circuitry**, ***P.C. Arnold***, Brooks Automation, Inc.

Characteristics of Pirani-style gauges and their causes for inaccuracy due to errors in temperature compensation will be presented. The principles of sensor thermal end losses as they contribute to pressure indication errors as well as errors due to changes in ambient temperature and non-uniformities in mounting structures will be discussed with special attention to reducing those uncertainties. The design, called Conductron (R) technology, is found to have usable pressure indication up to an atmosphere without utilization of gas convection enhancement geometry which causes orientation dependency. A geometry and method of operating the gauge, departing from the conventional Wheatstone bridge, that avoids common pitfalls of conventional Pirani gauge operation will be described. Certain operational measurements will be shown to avoid the more difficult determinations of (a) power lost to gas conductance and (b) measurement of sensor environment temperature, often used in both transducing these data to an indicated pressure and also providing temperature compensation. Also shown will be a unique method for arriving at the indicated pressure from those operational measurements. A pressure range from the low mTorr to atmosphere is encompassed by this design.

10:00am **VT-ThM7 Capillary Flow Meter for Calibrating Spinning Rotor Gauges**, ***R.F. Berg***, National Institute of Standards and Technology

Below 1 Pa, the NIST Pressure & Vacuum Group generates known pressures by flowing gas through an orifice with a calculable impedance. The gas flow is a leak from a small volume held at a higher pressure. Slowly inserting a piston into the volume holds the volume's pressure constant, and the known insertion rate and cross section of the piston, plus the pressure and temperature of the volume, yield the gas flow rate. This talk will describe the performance of new gas flow source based on a capillary flow impedance. Knowing the input pressure, output pressure, and temperature of the capillary yields the gas flow rate through the capillary. The capillary flow meter uses large pressures (30 - 300 kPa) that can be accurately measured, it requires no moving parts aside from valves, and it provides a steady flow for days instead of minutes. The new flow meter comprises a coil of quartz capillary with an inner diameter of 0.1 mm and a commercial pressure gauge package. Its maximum flow rate of 0.2 micromol/s (about 0.2 standard cubic centimeter per minute) covers the range that is useful for calibrating spinning rotor gauges. The flow meter relies on a hydrodynamic model that was developed for NIST transfer standards for larger gas flows with a relative uncertainty better than 0.1 %. A preliminary comparison at 0.1 micromol/s showed agreement between the piston flow meter and the capillary flow meter to within 0.2 %. Comparisons at other flow rates and extension of the hydrodynamic model to handle exit pressures below 30 kPa will be discussed.

10:20am **VT-ThM8 A Non-Destructive Partial Pressure X-Ray Analysis Method for Kr and Xe Gas Filled Encapsulated Devices**, ***P.F. Somssich***, *K.J. Zuk*, Osram Sylvania

A method to non-destructively measure the gas fill pressure of glass-encapsulated gas devices, e.g. lighting products will be described. The technique, first developed at GTE Laboratories in Waltham, MA, has recently been further expanded to include a wider range of devices (0.02cc and above) and pressures (15 Torr to 10 Atm.), all of which contain a xenon or krypton fill gas. When analysis results of an EDXRF instrument are combined with that of an absolute pressure-volume analyzer, calibration curves were generated allowing for subsequent non-destructive fill pressure determinations with an accuracy of approx. +/- 10%. The EDXRF analysis generates additional useful qualitative information which will also be presented, e.g. detecting the presence of iodine and other salts. Possible applications for 100% quality testing of products using a variant of the test, sub-second analysis, will be discussed.

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