Tuesday Morning, November 1, 2005

Vacuum Technology
Room 200 - Session VT-TuM

Total and Partial Pressure Gauging

Moderator: T. Gessert, National Renewable Energy Laboratory

8:40am **VT-TuM2 New Ignition Devices for Cold-Cathode Gauges*, B.R.F. Kendall,*** Elvac Laboratories*; E. Drubetsky,* Televac Division of The Fredericks Company

The discharge in a cold-cathode gauge does not start immediately when power is applied. In the absence of special starting devices the delay may be quite long, with large variations between successive starts. Average values typically range from seconds at 10@super -6@ Torr to hours or even days at 10@super -11@ Torr. For this reason, gauges which require frequent starting at very low pressures have sometimes been fitted with either radioactive or thermionic emitters to ensure relatively quick and predictable starting. Although effective, these solutions can cause other problems. Many laboratories are now reluctant to handle even weak radioactive sources, while the disturbance to the background pressure caused by some thermionic emitters can be significant. In an attempt to resolve these difficulties, we have tested diamond-like film emitters and electron generator arrays, both of which offer suitable fluxes of cold electrons for gauge starting. We have also made a detailed study of the physical processes occurring during gauge starting with thermionic electron sources. This has led to a very compact low-power emitter which greatly reduces thermal desorption during the starting process. The test gauges were double inverted magnetrons operating at pressures down to the 10@super -11@ Torr range.

9:00am **VT-TuM3 Selecting Vacuum Instrumentation for Your Applications*, C.R. Tilford,*** Independent Consultant **INVITED**

Vacuum users today are offered a wide variety of commercially-available vacuum instrumentation. But selecting adequate or best instruments for a particular application can sometimes be a daunting task since the only well defined parameter may be the cost. This talk will provide information to help users select instruments that will best meet their needs. This will include a brief description of thermal conductivity gauges, capacitance diaphragm gauges, micromachined electromechanical pressure gauges, ionization gauges and residual gas analyzers, and a discussion of the relative advantages and disadvantages of each type. Beyond this, experimental procedures will be described that can be carried out in the user's laboratory to determine important characteristics of specific instruments and, in some cases, make adjustments to optimize performance.

9:40am **VT-TuM5 Results of Performance Dependencies of Bayard-Alpert type Hot Cathode Ionization Gauges Upon Operational Parameters of Their Controllers*, P.C. Arnold,*** Helix Technology Corporation

An evaluation has been performed of the precision required to provide indicated pressure repeatability time-to-time and reproducibility controller-to-controller, with respect to the operational parameters of ionization gauge controllers. Gauge sensitivity of Bayard-Alpert type hot cathode ionization gauges has been studied and the dependence upon parameters of operation has been measured and will be displayed graphically. These measurements will allow a user to compare the precision of the userâ?Ts gauge controller to the needs of accurate pressure indication. The independent parameters varied were anode potential and cathode potential, with either cathode end at the cathode bias potential and with the cathode heating voltage applied at either cathode end, while the other variables of operation were held fixed. The fixed parameters were various electron emission currents, various nitrogen pressures, and several gauges. Another issue in ionization gauge operation is measurement of the base pressure of a vacuum chamber by a gauge attached to that chamber which is a continual problem in practical applications. Test data will be shown demonstrating that the magnitude of electron emission can significantly affect the indicated pumpdown rate observed for the chamber, or can significantly affect the steady state value of the indicated base pressure for a practical chamber in the UHV range.

10:20am **VT-TuM7 Residual Gas Analyzers as Total Pressure Gauges**, M. Maskell,*** Old Dominion University*; P. Adderley,* Jefferson Lab*; G.A. Brucker,* Stanford Research Systems*; C. Day,* Forschungszentrum, Karlsruhe*; G.R. Myneni,* Jefferson Lab

Residual Gas Analyzers (RGAs) provide many benefits over other types of gauges that measure total pressure only. RGAs give information about the specific composition of the residual gas in a vacuum system, and can be used for leak detection and diagnosis of other problems in a vacuum system. When the partial pressure capabilities of an RGA are needed, it is economically advantageous to be able to use the RGA as the systemâ?Ts total pressure gauge, rather than installing a total pressure gauge in addition to the RGA. The problem with using RGAs as total pressure gauges is that their sensitivity is affected by the mass of the gas they are detecting. These effects may be small for individual species of gas, but when the errors are added together in calculating the total pressure from the sum of the partial pressures, the total pressure measurement can become much less accurate than for gauges that measure total pressure only. This study is intended to find correction factors that can be applied to different gas species to make the RGA as accurate as any total pressure gauge. In this study, we use four Stanford Research Systems 100 AMU RGAs, an Ionivac IM-520 extractor gauge, an Ulvac AxTRAN gauge, and an MKS SRG SH-700 Spinning Rotor Gauge (SRG). First the SRG transfer standard is used to calibrate the extractor and AxTRAN gauges, by introducing various gases into the system, by direct comparison method. Then the RGA sensitivities for individual gas species are determined by comparing the partial pressure reading of the RGA with the extractor and AxTRAN gauge readings. Finally, a preselected gas mixture is introduced into the system, and the change in pressure reading on the extractor and AxTRAN are compared to the total pressure of the RGA with appropriate corrections to the various peaks of the RGA output. *This work was supported by U.S. Department of Energy Contract No. DE-AC05-84ER40150 and KATRIN International Collaboration at FZK in Germany.

10:40am **VT-TuM8 Calibration Systems Used for Calibrating Space Physics In-situ Particle Sensors*, M. Wüest,*** Astroglobo, Switzerland

Any measurement device needs to be calibrated to ensure that the signal output is in some known relation to the input. This is especially true for particle sensors sent into space. Those instruments can usually not be retrieved for recalibration in case questions about the validity of the measurements occur. Also, these in-situ space instruments are sometimes flown to locations where no other instrument has been before (e.g. Pluto). We will describe typical calibration systems for particle instruments for spacecraft such as plasma sensors, mass spectrometers, energetic neutral atom imagers or solid-state detector telescopes spanning the energy range from 0 eV to 10 MeV. We will touch upon selection for beam sources and beam monitors.

11:00am **VT-TuM9 Progress Towards User Oriented Vacuum Pressure Measurement*, M. Wuest,*** *R. Stocker,* INFICON Ltd., Liechtenstein

Since the beginning of vacuum measurements in the days of Torricelli, Pascal and von Guericke we have made a lot of progress in vacuum measurement. Measurement of total pressure in vacuum systems is characterized by an extremely large measurement range (> 14 decades) and the use of rather intransparent measurement principles such as heat conductivity of the gas, gas friction or ionization of the gas. This makes the measurement of the total pressure for the innocent user quite tricky as environmental parameters such as gas species, temperature, contamination or operating parameters must be considered. What efforts have been made in the past and what can be done in the future to provide the common user with simple to operate, accurate and reliable pressure gauges?

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