Tuesday Afternoon, October 21, 2008

Vacuum Technology
Room: 205 - Session VT-TuA

Vacuum Gauging and Calibration
Moderator: J. Setina, Institute of Metals and Technology

1:40pm **VT-TuA1 Pirani Vacuum Gauge for J-PARC 3GeV Synchrotron Vacuum System**, ***M. Kuroiwa***, *S. Fujii, N. Matsumoto, M. Sasaki*, Tokyo Electronics Co., Ltd., Japan, *N. Ogiwara, Y. Hikichi*, Japan Atomic Energy Agency

Turbomolecular pumps (TMPs) are used for not only rough pumping but also evacuation during beam operation. The backing pressure of the TMPs is always monitored with Pirani gauges. The control unit for the gauge has been newly designed, as the unit should be placed far from the gauge head which is located in a high level of radiation and electrical noise. We have adopted the combination of the constant current method with four-point probe method. Thus, with these techniques the output has been confirmed experimentally to be independent of the cable length, and less influenced by the noise. Generally the constant current method is not so suitable for measuring the higher pressure than that with constant temperature method, because the change in the output voltage so drastically decreases increasing the pressure over than about 100 Pa. As we have to measure the pressure up to about 1000 Pa precisely in order to monitor the backing pressure of TMPs, we have carried out the experiment about the change in the output as a function of the current. And, we have confirmed that the higher pressure can be measured when the higher current is passed. For example, we can measure the pressure less than 20 Pa at 50 mA, and the pressure ranging from 20 Pa to 1000 Pa at 90 mA, respectively. Thus the current is controlled in such a way that the set value is increased with the increasing pressure in several stages. On the other hand, to minimize radiation exposure during maintenance, it is necessary for the gauge head to have high toughness against the vibration and abrupt air inlet etc. Thus we tried to use W wire as the filament instead of Pt wire. However W wire would be unstable characteristic in high temperature status (over the 300C). It had might be affected by oxidation. So we have investigated other material for the filament. Now we have got good data by using W wire with gold coating 30 micrometer in a diameter. 30mA, 10ohm. Still we continue to have investigation to get more toughness and good condition for filament.

2:00pm **VT-TuA2 Hot Cathode Ionization Gauge Life Extension in the mTorr range by Operational Modifications**, ***P.C. Arnold***, Brooks Automation, Inc.

Improvement of hot cathode ionization vacuum gauge lifetime in the mTorr range by reducing the sputtering of gauge electrodes onto other components of the gauge will be demonstrated. Of special interest with respect to the sputtering are deposits on the cathodes and on the feedthrough insulators which result in impaired electron emission and leakage currents, both ultimately causing gauge failure. Analytical procedures which led to the sources of the sputtered material will be described. The sputtering reduction is accomplished by reducing the potential difference through which ions are accelerated, consequently reducing the impact energy on low potential electrodes and thus reducing the yield of the sputtering. Empirical data results will be shown to agree with theory and calculations. Other changes in gauge operation to implement these modifications and other improvements to enhance high pressure gauge life will be discussed.

2:20pm **VT-TuA3 Vacuum Metrology in Korea, Value Innovation for Customers**, ***K.H. Chung***, Korea Research Institute of Standards and Science (KRISS) **INVITED**

The Korea Research Institute of Standards and Science (KRISS) is the National Metrology Institute of Korea and responsible for the establishment, maintenance and dissemination of the national measurement standards. The Vacuum Technology Center (VTC) in KRISS has maintained the vacuum and leak standards from the atmospheric pressure down to $5x10^{-7}$ Pa. The vacuum standards systems for low, high, and ultra-high vacuum have been developed. Through bilateral comparisons with NIST, PTB, NMIJ, NPL (UK), IMGC and CCM key comparison for CCM.P-K3 and CCM.P-K4, it is recognized that the KRISS vacuum standards have reached the top level. In an effort to apply the vacuum and leak standards, VTC drew up and carried out the project “Base Construction for Vacuum Technology” from the year 1999 to 2007. The goal of the project was to establish the center in which almost all kinds of vacuum parts, devices, and equipments can be evaluated and performance tested. Its purpose is to help vacuum industries by providing them technical data needed in their development of vacuum equipments or processes. The next step for VTC is to develop the methods to diagnosis plasma processes in reaction chambers and precursor level and contaminations for advanced vacuum processes like semiconductor and display fabrication.

3:00pm **VT-TuA5 Investigations of Gas Dynamics in Capacitance Diaphragm Gauges**, ***M. Wüest***, INFICON Ltd, Balzers, Liechtenstein, *V. Kolobov, A. Vasenkov*, CFD Research Corporation

Industrial vacuum processes such as chemical vapor deposition (CVD) can affect the long-term stability of vacuum gauges. This sensor drift can be caused by deposition of process by-products on the surfaces of the sensor. Here, we present chemically reactive gas dynamics inside capacitance diaphragm gauges (CDG) in a CVD process. We present modeling results for the formation and deposition of process by-products in gauges with different geometries.

4:00pm **VT-TuA8 NIST Experience with New Non-Rotating Force Balanced Piston Gauges for Low Pressure Metrology**, ***J.H. Hendricks***, National Institute of Standards and Technology

The NIST Low Pressure Manometry Project maintains and operates primary standard ultrasonic interferometer manometers (UIMs) over the pressure range 0.01 Pa (vacuum) to 360 kPa (3.6 times atmospheric pressure). The typical gauging technologies used to cover this important pressure range have included high-accuracy capacitance diaphragm gauges (CDG), resonance silicon gauges (RSG), piezoresistive transducers (PZT), and piston gauges (PG). Over the past 6 years, a new type of customer gauge, the non-rotating force-balanced piston gauge or FPG, has been compared to the NIST 140 Pa UIM and 160 kPa mercury UIMs. The results of these customer comparisons will be presented along with the advantages and disadvantages of using this new high-accuracy device to both generate and measure pressures between 1 Pa and 15 kPa.

4:20pm **VT-TuA9 UHV Gauges in Theory and Practice**, ***M.L. Stutzman***, Jefferson Lab, *B.R.F. Kendall*, Elvac Laboratories

Many factors affect the measurement of pressure in the ultra-high vacuum regime. The operating theory of the various hot filament and cold-cathode gauges will be briefly reviewed, followed by a more in-depth discussion about the factors that affect the different gauges. Operational behavior and stability of both hot filament gauges, such as the Bayard-Alpert, Modulated BA and Extractor gauges, and cold-cathode gauges, particularly the inverted magnetron gauge, will be addressed.

4:40pm **VT-TuA10 A New Static Expansion System for the Spanish Metrology Center (CEM)**, *N. Medina, S. Ruiz,* Spanish Metrology Center (CEM), ***J. Gómez-Goñi***, Universidad Politécnica de Madrid, Spain

The Spanish Metrology Center, in cooperation with the Technical University of Madrid (UPM) is developing a static expansion system to be used as pressure primary standard in the range from 0,0001 Pa up to 1000 Pa. This standard will be used to calibrate capacitance diaphragm gauges and spinning rotor gauges. The system consists of five vessels: two 100 L-vessels, two 1 L-vessels and one 0,5 L-vessel. It also has two 300 L/s turbopumps (for N2) in order to evacuate the system. The system has been designed to be bakable up to 150 C in order to facilitate its degasification. The system is also endowed with 16 Pt100 temperature probes in order to measure the temperature distribution on the vessels. As auxiliary pressure gauges it also has one mass spectrometer, two ionization gauges, two spinning rotor gauges and two capacitance diaphragm gauges. The expansion factor determination is performed by gas accumulation method. The use of a Ruska 2465 pressure balance and a DHi FPG8601 pressure balance connected to the system through a 1 Torr differential capacitive diaphragm gauge is a special feature of this expansion factor determination. In this way we expect to reduce our measurement uncertainties.

5:00pm **VT-TuA11 Precision Volume Measurements: Challenges to Reducing Uncertainties**, ***S.M. Thornberg***, *J.M. Hochrein, J.R. Brown, R.D. Boyd*, Sandia National Laboratories

In order to reduce uncertainties in gas law calculations, one must address each of the major variables: pressure, temperature and volume. Very accurate temperature and pressure gauges are available and can be measured directly with commercial instruments. However, volume is typically the variable in the ideal gas law that consistently contributes greatly to the uncertainty when performing gas calculations. Reducing the volume uncertainty is particularly challenging because volume is not measured directly but is derived from other dimensional, pressure, volume, mass and/or temperature parameters. A delta-V/delta P method for accurately measuring volumes will be presented along with a discussion of ways used to reduce uncertainties and randomness. This method uses calibrated micrometers and precision pressure gauges in an “isothermal” (the goal is to reach a thermal stability where the temperature drifts less than 0.001°C during the 15 minute measurement duration) environment, all of which provides measurement repeatabilities within +/- 0.005 cc for a nominal 10 cc volume.

5:20pm **VT-TuA12 Thermal Management of Temperature Controlled Capacitive Diaphragm Gauges**, ***B. Andreaus***, *H. Hanselmann, M. Wüest, Ch. Berg*, Inficon AG, Liechtenstein

We present results from our thermal management studies for INFICON’s new, innovative family of SKY digital capacitive diaphragm vacuum gauges which covers a temperature range from controlled 45°C to hot 200°C as well as full-scales from 1000 Torr to 100 mTorr. A wide range of interface configurations is made possible by a flexible gauge power and communication interface platform. The heart of the design is a new programmable heater architecture that surrounds the high precision ceramic measurement cell and as well controls the temperature gradient between the gauge and the flange. Much thought has been put into heat distribution, material choice and mechanical design in order to achieve a compact and robust design that will provide stable measuring conditions while keeping electronics and software protected and functional in hostile process environments. We present results from our thermal management design studies, complemented by relevant performance characteristics of the gauges from validation experiments.

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