Tuesday Evening Poster Sessions, October 26, 1999

Vacuum Technology Division
Room 4C - Session VT-TuP

Poster Session

VT-TuP1 RGA Spectra of Vacuum System Contamination from Typical Cleaning and Handling Sources, ***R.S. Goeke***, *J.A. Romero,* Sandia National Laboratories

A library of typical RGA spectra has been generated for commonly used cleaning and handling materials that may lead to contamination in a baked vacuum system. Some of the materials analyzed were: Nitrile gloves, Brulin & Citrodet aqueous based cleaners, Fluoroware, Scotchbrite pads. Spectra were generated using a UHV desorption system with a Quadrupole Gas Analyzer. The purpose of the analysis was to generate a finger print library of possible contamination sources, which could be used to identify contamination in a production system. @FootnoteText@ Sandia is a multiprogram laboratory operated by Sandia corporation, a Lockheed Martin Company, for the United States Department of Energy under contract DE-AC04-94AL85000.

VT-TuP2 Application of Porcelain Enamel as a UHV Compatible Electrical Insulator, ***M.D. Mapes,*** Brookhaven National Laboratory, usa*; H.C. Hseuh, C. Biscardi,* Brookhaven National Laboratory

Many accelerator vacuum system components require electrical insulation internal to the vacuum system. Some accelerator components at Brookhaven National Laboratory are installed in UHV vacuum systems which require the insulation to have excellent vacuum characteristics, be radiation resitant and be able to withstand high temperatures when used on baked systems. Porcelain enamel satisfies all these requirements. This paper describes the process and application of coating metal parts with porcelain enamel to provide electrical insulation. The mechanical and vacuum testing of Marman flanges coated with porcelain and using metal Helicoflex seals to form a zero length electrical break are detailed. The use of porcelain enameled parts is attractive since it is fast, inexpensive and enviromentaly safe and most of all satisfies stringent vacuum system requirements.

VT-TuP3 High Resolution Quadrupole Mass Spectrometer for Light Masses, *A. Hofmänner, N. Müller,* ***H. Eppler,*** Balzers Instruments, Principality of Liechtenstein

Nuclear fusion experiments are performed with gas mixtures containing several components of low mass number (H2, D2, T2, 3He, 4He etc.). Quadrupole mass spectrometers with unit resolution can not separate these gases because of spectral overlaps even if spectrum- deconvolution algorithms are used. So high resolution mass spectrometry is required to separate the components with identical nominal mass numbers. For high resolution measurements in the low mass range a radiofrequeny-generator was developed that operates in the second Mathieu stability region. It drives a 16 mm rod diameter, 300 mm long mass filter at a frequency of 2.05 MHz and covers the mass range from 0.4 to 16.4 m/e. A cross- beam ion source with magnets produces ions with very good definition of ionization volume and energy. The deflection of the ions by 90Â° onto an off-axis SEM acts as an energy filter and so improves the resolution of the system. For example resolution of >400 at m/e= 4 is obtained with selectable resolution from 0.008 to 0.050 m/e at 10% peak height. The good stability of the mass scale allows for long term measurements without readjustment.

VT-TuP4 The Measurement of Multi-Layer Insulation (MLI) Outgassing and its Impact on Effective Cryostat Pumping, ***R.J. Todd***, *D. Weiss, D.J. Pate,* Brookhaven National Laboratory*; R. Davis,* Brookhaven National Laboratory, U.S.

The Relativistic Heavy Ion Collider (RHIC) is a superconducting particle collider that operates at cryogenic temperatures. The magnets used to bend and focus the beam are housed in twelve, 480 meter long, common cryostats. Outgassing rates of the MLI (multi-layer insulation) used in the cryostats were measured. Both the double aluminized mylar and polyester spacer material were tested for outgassing spectra and total quantity outgassed. To achieve a satisfactory base pressure in the cryostat, pumpdown estimates were made using the outgassing data. The number and size of pumps were varied to compare the effect on base pressure and water vapor loading of the pumps. Actual pumpdown curves were measured and compared with estimates. The effects of water vapor loading were also studied.

VT-TuP5 New-type Leak Detector utilizing Oxygen-Ion Conductor (I) -- Principle and Fundamental Performances--, ***K. Tatenuma***, *K. Uchida, K. Uta, T. Noguchi,* KAKEN Co., Japan*; H. Saeki,* Japan Synchrotron Radiation Research Institute, Japan*; A. Ando,* Himeji Institute of Technology, Japan*; T. Momose,* Miyagi National College of Technology, Japan

We developed a new-type leak-detector [LeakD] with an extraordinary wide pressure range by electrochemical measurement of a partial oxygen pressure utilizing the character and performance of oxygen-ion conducting ceramics, e.g. Yttria Stabilized Zirconia (YSZ). Tests using a vacuum apparatus composed of LeakD, a residual gas analyzer (RGA), a capacitance manometer, a Penning gauge, and a turbomolecular pump, confirmed that the responces of LeakD follows Nernst's law; e.m.f.=RT/nF[ln(P(O@sub 2@)ref/P(O@sub 2@)vac)], where e.m.f.: electromotive force (V), R: gas constant (8.314 J/molxK), T: temperature of probe (K), n: charge number of ionization (4: 2O@super 2-@), F: Faraday constant (9.65x10@super 4@ C/mol), P(O@sub 2@)ref and P(O@sub 2@)vac are oxygen partial pressures at a standard gas and a vacuum, respectively. An oxygen partial pressure in a vacuum is decided from e.m.f. LeakD is simple and small, which composed of YSZ ceramics tube (od.10 mm x id.7 mm x 90 mm (long), sealed at one ended) with porous platinum electrodes on inner and outer surfaces, a heater inserted into the YSZ tube to gain a high oxygen-ion conducting rate, a thermocouple, and two electric wires to measure the e.m.f. between two electrodes. To look for a leak point using LeakD, a gas excluded oxygen, e.g. nitrogen and so on, is blown to a point. LeakD is basically a general oxygen sensor using an oxygen-ion conductor. LeakD can detect a partial oxygen pressure by a function in the ranges from 10@super +2@ to 10@super -20@ atm or less; especially it has detectable leak rate both larger and smaller than He leak rate of RGA.

VT-TuP6 A Unique Cryogenic Pumping System for Space Simulation Chambers, ***A.D. Ketsdever***, Air Force Research Laboratory*; F.M. Lutfy, E.P. Muntz,* University of Southern California

To investigate the behavior of spacecraft interactions with the space environment and their own ambient atmosphere (caused by material outgassing or propulsive maneuvering), extremely low chamber background pressures and low backscattering rates from chamber walls are required. For meaningful spacecraft-thruster interaction studies, large pumping rates are also required to maintain background pressures at acceptable levels with high propellant flow rates. For the pumping rates required by some applications, cryogenic pumping appears to be the only adequate choice. In order to have a manageable chamber size, a unique geometrical configuration for the cryogenic pumping system was developed. The pumping system consists of outer liquid nitrogen panels which reduces the heat transfer from the outer chamber walls (300 K) to the inner gaseous helium panels (20 K). The inner cryogenic arrays consist of many radial fins which serve several purposes. First, the fin arrangement increases the available pumping surface area by an order of magnitude over a simple cylindrical geometry. Second, there are gaps between the radial fins which allow heavy ions and radiant heat to impact the graphite covered liquid nitrogen panels. In this way, sputtering from energetic ions is reduced and the liquid nitrogen panels remove most of the heat generated by the thruster. Finally, the fins reduce the solid angle for backscattering from non-condensing chamber surfaces to a particular area of interest. With this configuration, a total chamber pumping scheme has been adopted which uses all of the interior chamber surfaces to condense gases thus reducing backscattered molecules as much as possible.

VT-TuP7 Investigation for Pumping Speed and Foreline Performance of a Turbo Booster Pump, ***R.-Y. Jou,*** Precision Instrument Development Center,Taiwan, ROC, Taiwan, ROC

A compound or hybrid turbo pump constructed by both of turbo blade and drag pumping elements is usually designed to get the best attributes of both types of pump at the same time. However, the complexities in rotor geometry incur problems for specific applications. A rotor configuration design for the new turbo booster pump which is combined a TMP section with a spiral groove rotor by a specially designed connecting blade and is successfully predicted by both of CFD and DSMC simulation methodologies has been conducted. The predicted and testing results show that this pump is effective to operate in an inlet pressure range from 10-7Torr to around 10Torr with a maximum pumping speed appropriately 1000L/s in free molecular regime. Modern semiconductor processes require a large gas throughput and an ultrahigh vacuum (UHV) pump to create an ultraclean process environment. And to choice a proper foreline pump with effective foreline capabilities to reduce contamination to process chambers is an important consideration issue for pump designs and applications.

Therefore, it is imperative to investigate the foreline performance of this pump to optimize its function. In this article, a testing system designed to measure the pumping speeds and the foreline capabilities of this pump is constructed. A conductance valve is attached between the turbo booster pump and the foreline pumps to study the optimum foreline speed for this new pump. By controlling valve conductance between HV pump and foreline pump, and by measuring the variations of pressures and throughput at inlet and outlet, the influences of foreline's speed upon the total performance of turbo booster pump are explored. Besides, to reduce cost of the mechanical booster pump and inherently danger of contamination from it, the substitution possibility using this new pump is also discussed.

VT-TuP8 True and Measured Outgassing Rates of a Vacuum Chamber of a Reversibly Adsorbed Phase, ***K. Akaishi***, National Institute for Fusion Science, Japan; *M. Nakasuga,* Kyoto University, Japan; *Y. Funato,* Suzuka National College of Technology, Japan

We reported before that the outgassing rates measured in a 304 stainless steel chamber were dependent on pumping speed. So a pump down model based on the Temkin adsorption isotherm was constructed to explain theoretically the dependence of the measured outgassing rate on pumping speed. From the model an outgassing equation was derived, which describes the change of coverage of adsorbed molecules at the wall surface of the chamber with time. Two terms, true and measured outgassing rates of the vacuum chamber, appear in the equation, and it is shown that the true outgassing rate is proportional to the measred outgassing rate and the proportional constant reveals a reduction coefficient for the pumping speed of a vacuum pump. In this paper the magnitudes of the measured outgassing rates as a solution of the outgassing equation are estimated numerically as a function of pumping speed and compared to the measured outgassing data in experiment. A good agreement between theory and experiment for the measured outgassing rates is found.

VT-TuP9 A Vacuum Gauge System with a Self-compensator for Photoelectrons Produced in the SPring-8 Storage Ring, ***H. Saeki***, Japan Synchrotron Radiation Research Institute, Japan; *T. Momose,* Miyagi National College of Technology, Japan; *H. Yonehara,* Japan Synchrotron Radiation Research Institute, Japan

Some of the Bayard-Alpert gauges mounted on crotch chambers in the SPring-8 storage ring have indicated negative pressures at stored electron beam currents more than 5 mA. Simple measurements determined that negative and lower pressure indications of the vacuum gauges were caused by an influx of photoelectrons to the collectors. Therefore, to measure pressure more accurately in such a hot-vacuum environment, we proposed a vacuum gauge system with a self-compensator for photoelectrons from the environment. The gauge has a correcting electrode which only detects photoelectron current from the environment and obtains the actual pressure by compensating the current detected in the primary collector of the gauge. The estimated actual pressure of the gauge system with a self-compensator is adequate, compared with the apparent pressure detected with Extractor gauges. To make sure of the estimation, the new gauge system will be evaluated with an experimental vacuum chamber which makes such a hot-vacuum environment using an electron gun.

VT-TuP11 Study of Microgeometry of Activated Coals and Non-evaporable Getters, *S.B. Nesterov, Yu.K. Vassiliev,* Moscow Power Engineering Institute, Russia; ***G.L. Saksaganski***, The Efremov Research Institute of Electrophysica Apparatus, Russia

Determination of the pumping speed is of crucial importance by design of the surface action pumps. Pumping speed depends on the sticking coefficient value. Dependence of the integral sticking coefficient for the whole cryopanel on the local sticking coefficient in the concrete point is being determined in this paper. Real surface of the sorbent is not flat. So a molecule of the pumped gas can be reflected from this surface several times. The real surface of different sorbents - activated coals and non-evaporable getters is analysed by scanning tunnel microscope. To calculate dependence of the cryopanel integral sticking coefficient on the local sticking coefficient on the sorbent surface the test particle Monte-Carlo method is used considering the real surface of a sorbent. Integral coefficient values obtained during the experiment allow one to compute the local coefficient value for the concrete sorbent type. Obtained results for various types of sorbents may be useful for engineers constructors of surface action pumps.

VT-TuP12 RHIC Turbomolecular Pumping System, ***D. Weiss***, *R.C. Lee, D.J. Pate, L.A. Smart, D. Zigrosser,* Brookhaven National Laboratory

The Relativistic Heavy Ion Collider (RHIC) Project at Brookhaven National Laboratory (BNL), is a 3.8 km circumference collider commissioned earlier this year. The superconducting magnets used to steer and focus the ion beams, operate at 4.2K, and are contained in 28 cryostats of various sizes. A network of turbomolecular pumping stations (TMPS) is employed to maintain the rough vacuum in the magnet cryostats prior to cooldown of the machine, and to pump helium, which may be present in the cryostats due to leaks in the internal cryogenic distribution system. The design and operation of the TMPS and TMPS network is presented, with particular focus on the integration of off-the-shelf components with the BNL custom designed station logic controller (SLC). Additionally, the performance of the TMPS during the commissioning phase of RHIC is described.

VT-TuP13 Photon Stimulated Desorption Measurements of Copper Beam Chambers for the KEKB Collider@Footnote 1@, ***C.L. Foerster***, *C. Lanni,* Brookhaven National Laboratory; *K. Kanazawa,* KEK, Japan; *K. Shimotsuma,* KSA Inc.

KEKB is an asymmetrical collider constructed for the High Energy Accelerator Research Organization(KEK) in Ibaraki, Japan. The new collider utilizes two UHV ring chambers, one for a 3.5 GeV positron beam and the other for an 8 GeV electron beam, to study B-mesons. Two Samples, each one (1) meter long, of KEKB beam chambers were studied on newly constructed beamline U9a at the National Synchrotron Light Source (NSLS). Copper was chosen by KEK for the chamber construction material as it withstands high peak heat loads and also serves as a radiation shield. The samples have a circular cross section of 94mm inner diameter. After cleaning, flanges were electron-beam welded to the ends of the samples, and then the assembly was shipped to the NSLS, for installation in the PSD set up. Once sucessfully leak tested, the sample was installed in U9a, exposed to more than 10@super 23@ photons direct from the source at a critical energy of 595 eV, striking the sample at an incident angle of 100mrad. The major PSD yields for hydrogen, carbon monoxide, carbon dioxide, methane, and water vapor are reported as a funtion of accumulated photon flux and sample preparation. The results are compared with other PSD measurements on NSLS beamlines U9a, U10b, X28a, and those of other laboratories published for copper. @FootnoteText@ @Footnote 1@ Work performed under auspices of the U.S. Department of Energy, under contract DE-AC02-76CH00016.

Author Index

Bold page numbers indicate presenter