Vacuum Technology Division
Room 203B - Session VT-WeM
Vacuum Technology Developments

Moderators: Jason Carter, Argonne National Laboratory, Yulin Li, Cornell University

8:00am **VT-WeM1 Trace Helium Effects from High Pressure Swing Adsorption Nitrogen Generator on Semiconductor Capital Equipment Manufacturer***, William Johnson,* Applied Materials, Varian Semiconductor Equipment

A High Pressure N2 Pressure Swing Adsorption (HPN PSA) N2 generator was installed to replace the three LN2 bulk storage tanks on the AMAT VSE campus. An Ion Implanter has many multi-stage roots, exhaust lines and turbomolecular pumps that use GN2 as a purge gas. It was found that He introduced by the PSA GN2 generator was of sufficient quantity to raise the background level of many devices under test to the 10^{-6}sccs range, desensitizing the leak testing processes. This work will describe the basic PSA N2 generation process, the methods by which errant He entered the process and the method used to alleviate the excess He.

8:20am **VT-WeM2 Remote Handling Clamps for Flange Connections in Vacuum Service***, Ryan McCall,* Technetics Group

Sealing a vacuum connection remotely in a hostile or radioactive environment can present a difficult challenge for scientists and engineers. This critical application requires easy assembly and disassembly of the flange connection while reducing the number of individual components that must be handled. The QDS or Quick Disconnect System uses a contiguous chain clamp mechanism with two conical flanges and a customized seal that eliminates the need for loose bolts and nuts. In addition, the clamp connection can be fitted to a guide plate that ensures the clamp is always properly aligned. The QDS is of all metal construction and utilizes a spring energized metal seal to provide Helium leak rate performance with little or no permeation or outgassing. Typically, the QDS will require less space than a bolted flange and often requires less torque to create a tight seal.

9:00am **VT-WeM4 Role of Rotor Surface Conditions on Calibration Constant of Spinning Rotor Gauges***, Tim Verbovsek,* Institute of Metals and Technology, Slovenia

In spinning rotor gauges, measured pressure is inversely proportional to the tangential momentum accommodation coefficient (TMAC), a quantity which is affected by interactions between gas molecules and the rotor surface. This is why control over surface conditions of the rotor is extremely important, in order to accurately determine pressure. In our study, surface of rotor spheres were altered by various treatment steps, and changes in the TMAC with respect to the initial condition. For this purpose three different treatment steps were taken, each done over 24 hours. First the rotor sphere was vacuum baked at 300 °C. Next, the rotor sphere was heated again at 300 °C in oxygen at 1e-2 Pa. Finally, it was heated at 300 °C in pure hydrogen at 1e-2 Pa. In order to examine reproducibility of the method, two rotor spheres were simultaneously treated, while one rotor sphere was used as a control. TMAC of the untreated spheres and after each treatment step was determined using primary static expansion calibration system which was developed at Institute of Metals and Technology. Additionally, in order to determine the dependence of TMAC on the gas used, measurements were repeated for six pure gases; helium, methane, neon, nitrogen, argon and krypton. Results obtained showed a relative change in TMAC of up to 7% after heating in oxygen. Furthermore, a strong dependence on the gas used was observed, where largest change of the TMAC was observed for helium and neon.

9:20am **VT-WeM5 Condensation-based Low-grade Heat Powered Dual-chamber Vacuum Technology***, Tony Guo,* New Jersey Institute of Technology

Vacuum processing technologies are widely used in general industrial applications. Most of the current vacuum technologies such as positive displacement pumps, momentum transfer pumps, entrapment pumps and ejectors have to rely on electricity and /or compressor as the prime power source to generate the vacuum. Our technology provides an economic method to generate the vacuum by only using low-grade energy like waste heat, realized by steam condensation mechanism and dual-action piston-cylinder design. Our vacuum system is composed of 4 parts: one actuator-vacuum generation pump, where steam will be filled into and condensed to generate the vacuum environment; one extracting pump, deliver the vacuuming process, driven by the actuator through a linear connected piston; one boiler, to supply the steam to actuator as the prime energy source; an application chamber, connected with the extracting pump, to evaluate the vacuuming performance.

A system design of our technology will be presented and the vacuuming process will be demonstrated by 3D animation. A lab-scale prototype will be demoed via photos and video. The dynamic process of vacuuming for both actuator and driven pump has been mathematic modeled via MATLAB. For model correction, the tricky problems in the process, such as gas leakage and discharge, have been studied via CFD.

Key words: vacuum generation, low grade heat utilize, dynamic process model, CFD

9:40am **VT-WeM6 Vacuum Design and Testing of the ARIEL Radio Frequency Quadrupole Buncher and Cooler (ARQB)***, Geoff Hodgson, B. Barquest,* TRIUMF, Canada

The ARQB is an installation on the RIB (Radioactive Ion Beam) beamline in the new ARIEL (Advanced Radioactive IsotopE Laboratory) facility. The ARQB accepts continuous radioactive beam from future proton and electron-excited targets in the basement of ARIEL, and from existing targets in TRIUMF's ISAC facility. The buncher creates 10 to 100 Hz bunches for injection into the EBIS (Electron Beam Ion Source) for charge breeding. The ARQB is held at roughly +60 kV to electrostatically deaccelerate the beam to 150 keV at the injection optics. Between the ARQB and the EBIS, is a pulsed drift tube that reduces the ground potential beam energy to roughly 15 keV.

The cooling and bunching takes place in the core of the buncher in 0.05 mbar and ~80K helium. Helium is supplied through a stepper-controlled variable leak valve. Cooling is provided by a cryocooler thermally bonded to a copper jacket around the quadrupole core. The quadrupole electrodes and support structures create a differential pumping barrier between the core and the body of the ARQB chamber, which is expected to be held at 7e-4 mbar with one turbo pump. The injection and extraction electrodes create a second layer of differential pumping volumes, where pressure is expected to be 5e-5 mbar.

The design is based on the BECOLA beam cooler and buncher at Michigan State University. Vacuum testing is expected to start May 2018, and first stable isotope beam injected in October 2018. First radioactive beam from ISAC is expected in early 2019, and first beam from the ARIEL target in 2021.

Author Index

Bold page numbers indicate presenter

— B —
Barquest, B.: VT-WeM6, 1
— G —
Guo, T.: VT-WeM5, **1**
— H —
Hodgson, G.: VT-WeM6, **1**
— J —
Johnson, W.: VT-WeM1, **1**
— M —
McCall, R.: VT-WeM2, **1**
— V —
Verbovsek, T.: VT-WeM4, **1**