Vacuum Technology
Room 121 - Session VT3-MoA
Leaks, Flows, and Material Outgassing

Moderators: Marcy Stutzman, Jefferson Lab, **Alan Van Drie**, TAE Technologies

4:30pm **VT3-MoA-13 Practical Considerations When Using Low Carbon Steel for Extreme High Vacuum Applications***, **Aiman Al-Allaq,*** Old Dominion University*; M. Mamun, M. Poelker,* Thomas Jefferson National Accelerator Facility*; A. Elmustafa,* Old Dominion University

The very low outgassing rate of low-carbon steel – of the order 1000 times smaller than degassed stainless steel - suggests this material could provide the means to routinely achieve significantly better vacuum, well into the extreme high vacuum range. At Jefferson Lab, low carbon steel will be used for the construction of a new spin-polarized electron source. The improved vacuum we expect to achieve will ensure reliable and long-lasting beam delivery at milliampere beam currents, which is roughly one hundred times more current than today's state-of-the-art spin-polarized electron sources provide. However, reaping the full benefit of low-carbon steel depends on practical matters, namely, limiting the surface area of all non-low-carbon steel materials required to build a functional photogun. For example, the pressure reduction expected in a photogun with a surface area composed of just 10% stainless steel (e.g., the surface area contribution from an all-metal gate valve leading to the accelerator beamline) would be just a factor of ten, and not the factor of 1000 suggested by the ratio of outgassing rates. This submission describes outgassing rate measurements of chambers built using low-carbon steel and stainless steel and the ultimate pressures achieved for vacuum systems composed of low-carbon steel and stainless steel and pumped using a non-evaporable getter and ion pump. A factor of ten pressure reduction was observed in the system with a surface area dominated by low-carbon steel, consistent with MolFLow+ predictions based on measured outgassing rates. Lower pressures are expected when more thoughtful steps are taken to limit the amount of surface area of non-low carbon steel material.

4:45pm **VT3-MoA-14 Systematic Approach for Ultra-Clean Vacuum***, **Freek Molkenboer,*** TNO Science and Industry, the Netherlands

The demand for smaller, faster, higher accuracy and lower noise levels continues in the scientific field and applications i.e. microchip manufacturing. Contamination concerns that use to be not a concern now suddenly are. This also applies for the vacuum environment. To ensure the desired cleanliness a systematic approach is advised.

During the definition phase of a system, it is important to clearly define the needs of the system. A common methodology within systems engineering is using the v-model. After defining the needs of the system, the design and realisation phase of the system starts. The v-model ends with the validation that the needs are satisfied.

With the increasing cleanliness demands adding cleanliness needs or requirements during the definition phase will increase the successful outcome and will save overall cost.

In my presentation I will show the increase of complexity of a product when cleanliness is key for performance. For this I will use the design of a reflectometer that will be used to measure EUV reflection as a real life example.

5:00pm **VT3-MoA-15 Optimal Load Lock Pressure Measurement Technology?***, T. Swinney, G. Brucker,* MKS Instruments, Inc., Pressure and Vacuum Measurement Group*; **Cindy Merida,*** MKS Instruments, Inc., Pressure and Vacuum Measurement Group, USA **INVITED**

Transferring silicon wafers from ambient atmosphere into a semiconductor manufacturing cluster tool is a critical step that must be carefully sequenced and controlled. Every wafer must be (1) individually loaded into a load lock chamber through a loading port, (2) sealed against ambient pressure, (3) pumped down to a target pressure level and (4) transferred into a buffer chamber through a transfer port. Once at vacuum, the wafer can then be cycled across multiple process chambers. The same Load Lock chamber is then accessed, operated in a venting sequence, to return the wafer to ambient pressure conditions.

Careful control of differential pressures-i.e. ambient-to-load lock and load lock-to-buffer chamber, during pump-down and venting processes is critical to assure not only the compatibility of pressure levels between chambers and also to minimize the lifting and transport of damaging particles into the tool. Load lock pressure gauges, specifically designed to monitor and control both pump down and vent operations, are preferred pressure sensors for the Semiconductor industry. Load lock pressure gauges provide both differential and absolute pressure readings with accuracy levels required to ensure particles are not disturbed during wafer-load, -pump down, -transfer and -venting processes. Particle control has become critical as feature dimensions continue to drop.

MKS Instruments, Inc. offers multiple pressure measurement instruments that can assist Load Lock operation; however, its exclusive line of compact gauges delivering simultaneous absolute and differential pressure monitoring capabilities has rapidly become a new industry standard. With MEMS technology, two-sensor combination-Differential Piezo resistive diaphragm (PRD) plus Pirani sensor- and proprietary pressure calculation algorithms these sensors can provide accurate differential measurements between ambient and load lock chambers unmatched by any other multi-sensor combination in the market. Their ability to track ambient as well as chamber pressures allows particle-safe pump-downs and vents even after sudden changes in ambient pressure. The pressure measurement technologies in these device as well as planned future enhancements will be discussed. Interface options, calibration routines and control algorithms built into the load-lock sensors will also be described in detail.

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