Tuesday Lunch, November 1, 2005

Exhibitor Workshop
Room Exhibit Hall C&D - Session EW-TuL

Vacuum Components and Measurement Optimization

Moderator: C. Bryson, Apparati, Inc.

12:00pm **EW-TuL1 Cold Cathode/Quartz Crystal Combination Gauge**, ***E. Drubetsky***, Televac; *B.R.F. Kendall,* Elvac Associates; *N. Matsumoto,* Tokyo Electronics Co., Ltd, Japan; *N. Ohsako,* VISTA Corporation; *H. Hojoh,* Vacuum Products Corp.

Different types of combination vacuum gauges have been introduced lately in the attempt to cover a wide range of measurements from atmosphere down to ultra high vacuum. In most cases they utilize one thermal conductivity type of gauge (usually Pirani) and one ionization gauge (hot or cold cathode). A combination gauge containing a quartz crystal and a cold cathode sensor is described.The miniature quartz oscillator in the shape of a tuning fork is located in a small isolated chamber of the cold cathode tube.This design allows expansion of the measurement range from 10@-9@ Torr to atmospheric pressure.Tests confirmed measurement error is within ±10% for pressure from 0.001 to 760 Torr. Repeatability data and durability against process gases are also discussed.

12:20pm **EW-TuL2 Seal Life Test of 300mm Hybrid Chamber in PVD Thermal Cycle Environment**, ***J. Zhou***, *M. Evans, J. Klein, J. Vargas, Y. Zhou, R. Schmieding, H. Gao, D. Paul, B. Stimson,* Applied Materials

Physical vapor deposition (PVD) is a key process in semiconductor wafer manufacturing. A new 300mm PVD chamber design consists of two pieces: an aluminum chamber body and a stainless steel bottom plate with a Viton O-ring seal. The reliability of the bottom seal is a concern, as elevated temperature exposure may cause the O-ring to fail by heat hardening, reducing equipment uptime. Thus, an accelerated test was designed to evaluate the O-ring lifetime before vacuum leakage. In commercial use, 300mm wafer diameter PVD chambers need to be heated for three hours at 80% lamp power about once a week. Tests were conducted with: 1) 100% lamp power during heating; 2) tight vacuum pass/fail criterion; 3) increased temperature in one of the test chambers than the default 96Â°C setting to look at worst case. Each thermal cycle consisted of three-hour heating and three-hour cooldown. After every 10 cycles the test chambers were cooled below 40Â°C to obtain the specified vacuum. Seal leakage was evaluated every 20 cycles using an in situ gas analyzer. Test chambers passed 520 thermal cycles without measurable vacuum degradation. Assuming 52 thermal cycles are equivalent to one year of seal life, the test chambers were demonstrated to have a "thermal equivalent" seal life of 10 years, which is much longer than the design goal of five years. The test results, together with post-test O-ring FTIR analysis, provide high confidence in O-ring reliability, and establish a methodology to evaluate PVD chamber seal life.

12:40pm **EW-TuL3 Robust System Identification and Optimized Tuning for Control of Evaporation Processes: Benchmark Study Results of Manufacturing Performance**, *G. Reimann, B. Vattiat,* ***M. Gevelber,*** Cyber Materials, LLC; *J. Hildebrand, C. Hildebrand,* Maxtek, Inc.

Crystal monitors have been used for over 30 years to provide real-time control of evaporation sources in order to maintain a desired deposition rate. However, the performance of these systems is dependent on proper choice of controller gains. Review of a number of commercial operations has revealed that many controllers are mistuned and fail to compensate for large deposition rate variation. In many cases, poor controller tuning actually magnifies rate variations. These significant variations adversely impact coating quality, reduce yield, and limit throughput. In an evaporation system, the controller must be tuned to react to the dynamic response characteristics and disturbances typical of evaporation processes. The tuner will need to robustly deal with the process nonlinearities and variations that occur during a run. While a number of tuning approaches have been developed or suggested for controlling evaporation processes, none are optimized for the specific conditions observed in the processes, nor are they designed to handle the variety of conditions that typically occur. We present our work on a robust and automatic method for obtaining optimized controller tuning. The performance of the proposed tuning is evaluated under manufacturing conditions. We propose a two step process that first robustly identifies the system characteristics, and then applies an appropriate optimization scheme that selects controller gains based on the identified process characteristics. By robust, we mean that the identification process works despite all variations observed in practice including arcing, nonlinearities due to operating point dependency, and variations in system characteristics. In addition to describing the new robust and optimized controller tuning scheme, this paper reports our initial benchmark performance results of the new controller tuning system, as well as our analysis of system drift in several manufacturing systems.

1:00pm **EW-TuL4 Internet-Enabled Vacuum Training System**, *R. Groom,* ***S. Hansen,*** MKS Instruments, Inc.; *Y.J. Lee, M. Moslehi,* Semizone, Inc.

Realizing that an understanding of vacuum and related process monitoring and control instrumentation is a key area for individuals who are technical workers in the semiconductor industry, MKS developed an integrated set of instructional literature and hardware for the teaching of vacuum and instrumentation practice. At the center is a table-top vacuum training system (VTS) which replicates the features and functions of a full-scale process tool. In 2004 MKS Instruments partnered with Semizone, Inc. to implement an Internet-enabled version of this vacuum training system. The system consists of most components found in a typical vacuum process tool including plasma chamber, high vacuum valve, throttling valve, mass flow controller, capacitance manometer, Pirani gauge, hot cathode ion gauge, RGA, and other components. Because the system was re-designed and built as an Internet enabled tool, all components (including components that are typically manually controlled) can be remotely actuated. The various sensors and actuators on the VTS interface with the equipment controller/server through adapters that convert legacy protocols into TCP/IP protocol. The equipment controller/server obtains the sensor readings and provides the control commands to the VTS. The equipment controller/server also communicates with the end user through client software using SOAP/XML protocol over a secure intranet or Internet connection. The client software provides graphical user interface and data analysis/interpretation tools. The remote access to the VTS is integrated with other Internet-based content including lecture modules, live video feeds, discussion forum, and online simulators.

1:20pm **EW-TuL5 CompuVac NT - A New Generation Vacuum System Design Tool**, ***P.J. Klingner,*** Leybold Vacuum GmbH, Germany

Vacuum system design which meet the customer's requirements best is the goal of any vacuum equipment manufacturer. To achieve this the reliable modeling of the adequate system of pumps and conductances is a necessary and decisive precondition. Being in use for nearly two decades, Leybold's purpose-built software tool CompuVac has been successfully revised and transferred to the Windows@super TM@ environment now. The program helps to predict essential parameters as the effective pumping speed, pump down behaviour and power consumption reliably. Problems specific to a given vacuum system can be detected and purposively solved.

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