

Wednesday Afternoon, November 15, 2006

Vacuum Technology Room 2000 - Session VT-WeA

Space-based Vacuum Applications and Instrumentation; Panel Discussion on Vacuum Science and Technology

Moderator: P.J. Abbott, National Institute of Standards and Technology

2:00pm **VT-WeA1 Experimental Investigation of the Near-Earth Space, M. Wüest**, INFICON GmbH, Switzerland **INVITED**

Since the days of the first launch of an orbiting satellite containing scientific instrumentation in January 1958 the space environment in the vicinity of Earth has been studied in more and more detail. Substantial improvements have been made to the space-based instrumentation since then. In the area of low energy particle instruments they have evolved from the simple cylindrical electrostatic analyzer to complicated time-of-flight mass spectrometers. I will trace the evolution of the space physics instrumentation in terms of measuring capability and how this contributed to a better understanding of near-Earth space.

2:40pm **VT-WeA3 Bayard-Alpert Gauges for Space Research: Techniques and Results, J.H. Clemmons**, The Aerospace Corporation

Two variants on a common spaceborne ionization gauge design are discussed. The miniature, commercially-available sensors used to minimize the required spacecraft resources are described. Several special features of the controller are demanded by scientific use in space, including high-precision, high-rate sampling, DC filament regulation, and space compatibility, are presented and discussed. The variant used for suborbital flights, which employs 1 kHz sampling and an accommodation chamber designed to have a response function between that of a planar aperture and a pitot tube, as well as results from several flights, are presented. The variant used for orbital flights, which features a more traditional accommodation chamber with a planar aperture and high-reliability electronics, as well as results taken from about one year of data collection, are presented. A special mode of the instruments, designed to provide crude composition information, is also discussed and evaluated.

3:00pm **VT-WeA4 Ground Simulation Studies of Commercially Available Coatings and Adhesives for Low Earth Orbit Space Environment Applications, A. Laikhtman, R. Verker, Y. Noter, E. Grossman, I. Gouzman**, Soreq NRC, Israel

This work is dedicated to comparative ground simulation studies of two representative groups of materials: (i) black paints and (ii) adhesive coatings. Some of them are already in use in orbiting spacecrafts, mainly in optical systems, while others are considered for such applications. The paints and coatings discussed here are silicone-based or inorganic, alumina-based. Outgassing properties of the discussed materials were first evaluated by a standard outgassing test according to ASTM E595. These measurements do not provide, however, any information about the kinetics of the outgassing processes. The kinetic parameters characterizing outgassing of materials are of great importance, since they are used to evaluate the contamination and the associated degradation of optical space systems. Silicone-based materials are known to be a threat as a source of contamination, while inorganic coatings may be highly porous and, therefore, may aggregate molecular fragments from their environment followed by desorption of these fragments and contamination of neighboring parts. The experimental procedure was based on in situ monitoring of the contaminants by a quartz crystal microbalance (QCM) in a modified ASTM E595 system. It involved the following stages: (a) holding the sample at high temperature while keeping the QCM at low temperature; (b) cooling the sample and keeping it at room temperature without changing the QCM temperature, in order to isolate the contaminants re-emission process; and (c) increasing the QCM temperature to study the effect of temperature on the re-emission kinetics. In addition, chemical identification of the residual contaminants was performed by FTIR and UV spectroscopic measurements. Considerable differences in the outgassing kinetic parameters and contamination potentials were observed between the discussed materials. An analytical model was developed to derive the outgassing and re-emission kinetic parameters from the experimental data.

3:20pm **VT-WeA5 Report from the Mars Chapter, M.H. Hecht**, Jet Propulsion Laboratory, California Institute of Technology **INVITED**

This august organization represents generations of vacuum lore acquired for the sole purpose of preventing 100,000 Pa of a predominantly

oxygen/nitrogen mixture laced with rare gases from fouling up important scientific experiments and lucrative fabrication processes. With this problem largely solved, our attention has fastened on the experiments and processes themselves, as well as their products, which now form the subject of most of our symposia. But for those of us in the Mars exploration business, constrained to pitifully small mass and power budgets and faced with excluding only 1,000 Pa of predominantly carbon dioxide, a new set of solutions to the original problem becomes attractive. The native atmosphere is thin enough for some experiments that would prefer vacuum on Earth, such as x-ray analysis or scanned probe microscopy, but is more severe than Earth with respect to others, such as those sensitive to triboelectricity. Getters are sufficient for some applications, including mass spectroscopy. This talk will cover some of the basic characteristics of working in the martian atmosphere (thermal properties, for example), and will review the adaptation of analytical instruments to that environment.

4:00pm **VT-WeA7 Evacuation Equipment and Techniques for Space Simulation Chambers, J.P. Luby, R. Amos**, BOC Edwards

Vacuum chambers used for space simulation often require large vacuum pumping systems or multiple, smaller vacuum pumping systems to accomplish evacuation in a reasonable time frame. Appreciable high vacuum pumping speed is required to complete evacuation and maintain vacuum at desired levels. There are numerous technical and economic challenges, as well as special design criteria that should be considered when selecting equipment and implementing techniques for large chamber evacuation. In this paper, selection criteria for rough vacuum and high vacuum equipment is reviewed with a focus on system sizing, system configuration, vacuum system operation and maintenance.

Author Index

Bold page numbers indicate presenter

— A —

Amos, R.: VT-WeA7, **1**

— C —

Clemmons, J.H.: VT-WeA3, **1**

— G —

Gouzman, I.: VT-WeA4, **1**

Grossman, E.: VT-WeA4, **1**

— H —

Hecht, M.H.: VT-WeA5, **1**

— L —

Laikhtman, A.: VT-WeA4, **1**

Luby, J.P.: VT-WeA7, **1**

— N —

Noter, Y.: VT-WeA4, **1**

— V —

Verker, R.: VT-WeA4, **1**

— W —

Wüest, M.: VT-WeA1, **1**