The 2005 Colloquium Series

Characterization of Life-Limiting Mechanisms of Ion Thruster Discharge Cathodes

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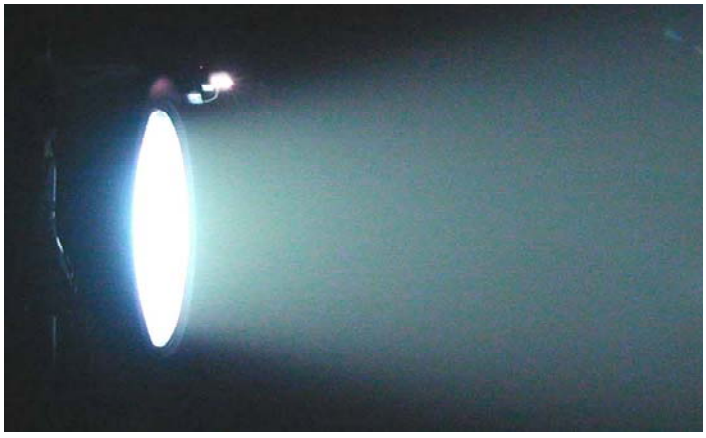
1:30 P.M.
Ford Seminar Room, ME 256

ABSTRACT
Ion thrusters are being considered for a wide range of space missions and spacecraft power levels, ranging from 500-W mini-probes to 200 kW Prometheus-class nuclear-powered vehicles. The NASA Solar Electric Propulsion Technology Application Readiness (NSTAR) ion thruster serves as the reference engine for all current ion thruster development activities at NASA. Several wear-tests on NSTAR-derivative hardware have been conducted to demonstrate long-duration operation and to identify life-limiting phenomena. One of the principal failure mechanisms identified during these wear tests was erosion of the discharge cathode assembly (DCA). Severe DCA erosion was observed in the 2000-hr development wear-test in preparation for the Deep Space 1 (DS1) mission, which was the first application of ion engine technology for primary propulsion. A keeper electrode was introduced as an "engineering solution" and appeared to have eliminated this failure mode. However, a recent long-duration life test of the DS1 spare flight thruster illustrated vividly that DCA erosion remains one of the key life-limiting mechanism of ion thrusters. My talk will review an ongoing, two-pronged approach the Plasmadynamics and Electric Propulsion Laboratory (PEPL) has taken in characterizing DCA erosion.



Ion thruster in operation at the University of Michigan

About the Speaker — DR. ALEC D. GALLIMORE is Professor of Aerospace Engineering and Professor of Applied Physics at the University of Michigan where he directs the Plasmadynamics and Electric Propulsion Laboratory. Professor Gallimore is also the director of the NASA-funded Michigan Space Grant Consortium. He received his B.S. in Aeronautical Engineering from the Rensselaer Polytechnic Institute in 1986, and his M.A. and Ph.D. in Aerospace Engineering from Princeton University in 1988 and 1992, respectively. His primary research interests include electric propulsion, plasma diagnostics, space plasma simulation, and electrode physics. He has experience with a wide array of electric propulsion technologies including Hall thrusters, ion engines, arcjets, and MPD thrusters, and has implemented a variety of probe, microwave, and optical/laser plasma diagnostics. The author of more than one hundred and fifty journal and conference papers, and two book chapters on electric propulsion and plasma physics, Professor Gallimore was the recipient of *Outstanding Accomplishment in Aerospace Engineering Award*, by the University of Michigan in 2002, the *University of Michigan Faculty Career Development Award* in 2000, the *Class of '38E Prize* for teaching, service, and research in 1996, and received teaching awards in 1996 and 1994 from Sigma Gamma Tau, the Aerospace Engineering honor society. In 1994 he was awarded the *Crystal Image Award for Technical Achievement* by the National Technical Association for science educator of the year, and received the *Best Paper on Electric Propulsion Award* for work presented at the 1998 Joint Propulsion Conference. Professor Gallimore serves on the American Institute of Aeronautics and Astronautics (AIAA) Electric Propulsion Technical Committee, on NASA's *Nuclear-Electric Propulsion Technology Assessment Group*, and on the United States Air Force *Scientific Advisory Board*. Professor Gallimore is an Associate Editor for the *Journal of Propulsion and Powe*r and is an Associate Fellow of the AIAA.

An informal coffee & cookie reception will after the lecture at 2:30 p.m. in ME 254