OVERVIEW AND PERFORMANCE OF A WAVEGUIDE ECR PLASMA CATHODE WITH PERMANENT MAGNETS*

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A waveguide electron cyclotron resonance (ECR)-heated plasma cathode has been developed as a long-lived alternative to the thermionic emitter-based hollow cathode assembly (HCA) for space applications, primarily as a neutralizer source for electric propulsion systems used on long-term missions. The use of a microwave discharge as an electron source could avoid lifetime limitations of the well-established HCA, which arise from erosion of the emissive insert and evaporation of impregnate material in the insert. The device to be presented utilizes traveling microwaves, as opposed to direct heating from a wire antenna, to generate the source discharge. As a result, this plasma source also avoids lifetime constraints associated with other microwave plasma cathodes due to antenna erosion.

This presentation will briefly introduce the waveguide plasma cathode and present an overview of the significant performance results to date. During initial tests, the source described here was able to deliver up to 1.7 A of electron current on argon, with a gas utilization of nearly 800 percent and total power consumption of 115 W/A, as presented elsewhere.[1] Since then, additional testing has shown that the source can deliver more than twice as much current and even greater gas utilization. These updated results are the focus of this presentation, along with the relevant physics behind the operation of the source. The performance of the source while running on xenon feed gas is discussed as well. New Langmuir probe data have been recorded within the visible plume which emanates from the source, as well as within the current extraction orifice at the exit plane of the source. The probe data are discussed and compared with expected results from previous tests.

1. Weatherford, B. and Foster, J., "Initial Performance of a ECR Waveguide Plasma Cathode with Permanent Magnets," 31st International Electric Propulsion Conference, 20-24 Sept., 2009, Ann Arbor, MI, Paper No. IEPC-2009-211

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