The EPIC-2 Bipropellant Plume-Induced Contamination Test Program and Application to Europa Clipper, Lunar Gateway and the International Space Station Programs

Carlos Soares*[1]

[1]Jet Propulsion Laboratory – United States

Abstract

The EPIC-2 (Europa Plume Induced Contamination) test program was developed for application to multiple flight projects, which include JPL's Europa Clipper and NASA JSC Gateway and International Space Station programs. EPIC-2 builds on the foundations of a previous test program (EPIC1,2), a hydrazine monopropellant thruster plume induced contamination and effects test campaign in support of advanced technology development for JPL's Europa Lander mission concept. EPIC-2 was developed to support both JPL and NASA JSC's projects, in collaboration with an ESA test campaign. Thruster plume induced contamination and effects testing is both complex and expensive. This joint JPL/NASA JSC/ESA/DLR test campaign demonstrates that this type of collaboration can reduce test costs and provide critical data to inform flight projects and for application to advanced technology development. This paper discusses the multiple test objectives and test program development. Plume induced contamination and effects from an MMH/NTO bipropellant thruster was studied in the high-vacuum plume test facility for chemical thrusters at DLR Göttingen, STG-CT. A newly developed resistivity sensor employing an Inter Digitated Electrode (IDE) sensor was developed specifically to make measurements of resistivity of plume contaminant deposits. A cryotrap system was also developed to capture plume effluents for analysis using prototype science instrumentation. A number of representative material samples were exposed to the freely expanding pulsed thruster plume for subsequent in-depth analysis at JPL and NASA JSC. The plume gas is monitored in-situ with a mass spectrometer and quartz-crystal microbalances, while non-gaseous ejecta is recorded with a high-speed camera setup. With the detailed data chemical analysis ongoing we report on the measurements obtained during the campaign and immediate post-test observations.

Keywords: plume induced contamination, plume effects, plume, surface interactions, contamination, contamination testing, contamination modeling and analysis

*Speaker