Paper ID: 19213
oral

SPACE PROPULSION SYMPOSIUM (C4)
Electric Propulsion (4)

Author: Ms. Daniela Pedrini
Università di Pisa, Italy, danielapedrini@virgilio.it

Dr. Riccardo Albertoni
Sitael Spa, Italy, r.albertoni@alta-space.com
Mr. Fabrizio Paganucci
Sitael Spa, Italy, f.paganucci@alta-space.com
Prof. Mariano Andrenucci
Sitael Spa, Italy, m.andrenucci@alta-space.com

MODELING OF LAB6 HOLLOW CATHODE PERFORMANCE AND LIFETIME

Abstract

Thermionic hollow cathodes are currently used as sources of electrons in a variety of space applications, in particular as cathodes/neutralizers of electric thrusters (Hall effect and ion thrusters). Numerical tools are needed to guide the design of new devices, since multiple geometrical parameters influence the cathode performance as well as plasma diagnostics are hindered by the small size and the high operating temperatures. A numerical model was developed to assess the performance of orificed hollow cathodes for ion and Hall thrusters, with a focus on the operational lifetime. The cathode architecture consists of a refractory metal tube with an internal electron emitter made of lanthanum hexaboride (LaB6). The choice of LaB6 accounts for the reduced evaporation rate, the low sensitivity to poisoning and the absence of an activation procedure with respect to oxide cathodes. A LaB6 emitter is thus a valuable option for long-lasting cathodes, despite its relatively high work-function and reactivity with many refractory metals at high temperatures. The suggested reduced-order model self-consistently predicts the key parameters of the cathode operation, shedding light on the power deposition processes as well as on the main erosion mechanisms. The importance of the lifetime prediction is tied to its impact on the operational lifetime of the thruster to which the cathode is coupled. Preliminary results showed good agreement with the experimental data available from the literature for different operating conditions and power levels. Future developments of this study will include a more extensive comparison between theoretical and experimental data, considering cathodes of various size and operating conditions.