

SPACE PROPULSION SYMPOSIUM (C4)
Electric Propulsion (4)

Author: Dr. Riccardo Albertoni
Sitael Spa, Italy, r.albertoni@alta-space.com

Ms. Daniela Pedrini
Università di Pisa, Italy, daniela.pedrini@for.unipi.it
Prof. Fabrizio Paganucci
Università di Pisa, Italy, f.paganucci@ing.unipi.it
Prof. Mariano Andrenucci
Sitael Spa, Italy, m.andrenucci@alta-space.com

DISPENSER HOLLOW CATHODE DESIGN FOR LOW-POWER HALL EFFECT THRUSTERS

Abstract

The operation of hollow cathodes greatly impacts the overall performance of sub-kilowatt electric propulsion systems, such as Hall effect thrusters, suitable for station-keeping and attitude control of small satellites. In this context, the design of an efficient cathode is of primary importance in order to keep the power and propellant consumption within reasonable levels (roughly 10%) of the respective values for the entire system. To this aim, a thermionic hollow cathode for a 100-W Hall thruster has been designed and preliminarily tested at Alta. The cathode features a dispenser impregnated emitter, providing the required electrons by means of a chemically activated metallic surface. Despite the higher susceptibility to contamination with respect to bulk emitting materials, this kind of emitter has been selected due to the low work function (about 2.1 eV compared to 2.7 eV for lanthanum hexaboride), which allows for the operation at lower temperatures. As a matter of fact, the thermal management of the cathode assembly is particularly challenging when scaling the cathode down to low levels of power. The cathode includes an orifice designed to extend the spot-mode operation to low values of mass flow rate. The design of the heater, required for the activation process of the emitter, is discussed along with cathode lifetime, calculated on the basis of the impregnate depletion at the predicted surface temperature. Preliminary experimental data are presented and discussed, showing a good accordance with the theoretical results obtained from a previously developed model, describing the performance of thermionic hollow cathodes.