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Sitael Hollow Cathodes for Low-Power Hall Effect Thrusters

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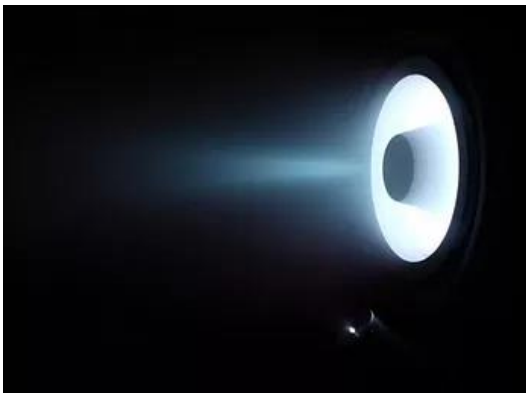

Figure 1. HC1 operating with HT100D [1]

Low-power Hall Effect Thrusters (HETs) belong to a class of electric thrusters with an operating power lower than 500 W. The application of this class of HETs is suited for small satellites for telecommunications and Earth observation missions to perform a variety of missions, namely drag compensation in LEO and VLEO, accurate final orbit insertion, and de-orbiting at the end of the mission. Sitael is active in this field, through the development of two HETs, HT1 00 and HT400, having a nominal power of 100 W and 400 W, respectively. HT100 is a permanent-magnets thruster operating in the 100 – 250 W range, providing a thrust between 4 and 13 mN, and a specific impulse between 900 and 1400 s. HT400 operates at 350 – 750 W of power, 20 – 45 mN of thrust, and 1300 – 1700 s of specific impulse. Two cathodes have been developed and tested, referred to as HC1 and HC3, conceived for HT100 and HT400, respectively. Both the cathodes are based on Sitael heritage in the theoretical modeling and experimental activities of such devices, and rely on lanthanum hexaboride emitters. HC1 is a cathode designed to provide a discharge current in the 0.3 – 1 A range, operating in steady-state conditions at mass flow rates between 0.08 and 0.5 mg/s. Fig. 1 shows HC1 during steady-state operation with HT100D [1]. HC3 was designed for the range 1 – 3 A of discharge current, and 0.08 – 1 mg/s of mass flow rate. Both HC1 and HC3 have an expected lifetime higher than 10 4 hours, estimated on the basis of the emitter evaporation at the operating surface temperature, computed with the aid of the previously developed model [2]. Experiments were carried out, including preliminary characterization campaigns of each of the two cathodes and coupling tests with the respective thrusters. The collected data are presented and discussed with reference to the model predictions, showing a good agreement between theoretical and experimental results.

[1] Ducci, C., Albertoni, R., and Andrenucci, M. (2013). HT100D Performance Evaluation and Endurance Test Results. IEPC-2013-140, 33rd International Electric Propulsion Conference, Washington, D.C., USA.
[2] Pedrini, D., Albertoni, R., Paganucci, F., and Andrenucci, M. (2014). Theoretical Model of a Lanthanum Hexaboride Hollow Cathode. IEEE Trans. on Plasma Sci., 43(1).

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