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Alternative Propellants for Low Power Hall Effect Thrusters

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Presently, xenon is by far the most used propellant in Hall effect thrusters (HETs) for space applications. However, alternative, more available and less expensive propellants are currently considered and tested, as for instance krypton and iodine. In particular iodine is attractive for several features it possesses. As a matter of fact, iodine and xenon atomic mass and first ionization energy are very close and thruster performance, in terms of thrust density, thrust efficiency and specific impulse, have proved to be almost the same [1]. Moreover iodine is solid at ambient temperature and pressure, with a density about four times the density of xenon stored at 200 bar at ambient temperature. Iodine cost is currently less than one tenth the cost of xenon. Gaseous iodine at low pressure (up to about 10 kPa) can be obtained by heating the solid propellant at low temperature (up to about 100 °C). Hence, relatively simple and compact feeding system can be conceived, making iodine particularly suitable for low (less than 1 kW) and very low (less than 100 W) power HETs and, potentially, for micro-propulsion applications. However, since iodine is condensable at moderate pressure and temperature and reactive with several materials, included materials used in thrusters and spacecrafts, its adoption needs a thorough assessment. The talk illustrates the most recent results of an activity carried out at the University of Pisa for the development of a iodine feeding system for a 100 W class HET [2]. A first prototype and the relevant test facility are described. The thermostatic test facility for iodine/materials interaction tests is illustrated and preliminary results are shown.

[1] J. Szabo, et al., “Iodine Plasma Propulsion Test Results at 1-10 kW,” *IEEE Trans. Plasma Sci.*, Special Issue –Plasma Propulsion, 43, 2015, 141-148.

[2] F. Paganucci, et al., “Development of an Iodine Propellant Feeding System for Electric Propulsion”, *Space Propulsion* 2016, SP2016_3124925, 2-6 May 2016, Rome, Italy.