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DEVELOPMENT OF A KW-LEVEL PLASMA THRUSTER IN PROJECT SAPERE –STRONG

Abstract

Recent advances in electric space propulsion systems have led to the development of Radio-Frequency plasma thrusters based on Helicon technology (Helicon Plasma Thruster, HPT). HPTs represent an innovative type of space thruster, currently receiving the attention of the research community thanks to (i) a very simple structure, based on a dielectric tube(discharge chamber) in which plasma is generated, an RF antenna for propellant ionization and a magneto-static field which confines and conveys the plasma, (ii) the lack of neutralization cathodes and other electrodes immersed in the plasma, resulting in a potentially long lifetime and (iii) the potential capability of operating with different propellants, both mono-atomic and molecular. The Center for Space Studies and Activities (CISAS) "G. Colombo", of the University of Padua, gained in these years a considerable experience on HPT development and testing, within the frame of the EU project HPH.Com, carried out at CISAS from 2008 to 2012 with the objective of developing a 50 W HPT employing Argon [2], during which an innovative, high performance RF plasma source was developed. Work at CISAS is currently focused on the development of a kW-level plasma thruster, in

the frame of the research project SAPERE-STRONG, founded by the Italian Ministry for University and Research (MIUR) and coordinated by Thales Alenia Space Italia (TASI). Within this activity an innovative laboratory test-bed for the characterization and optimization of kW-level thruster was developed, on the basis of preliminary estimations carried out by means of a zero-dimensional plasma source model developed at CISAS; the system includes (i) an highly reconfigurable plasma source and (ii) an array of plasma diagnostics, featuring a microwave interferometer for plasma density measurement, Faraday probes and optical spectroscopes. The test-bed constitutes a development of HPH.Com technology and was designed in order to allow thruster re-configuration, in terms of geometry, RF antenna, magnetic system and propellant type. The system has currently been manufactured and tested at the intermediate power level of 400 W using argon, in order to provide preliminary information on the power scaling of the plasma source useful for codes validation. These efforts are intended as a preliminary test required to reach the target power of 1 kW. Tests with propellants different from argon are also planned. This paper will include (i) an overview of the design of the plasma source, (ii) the results of testing at 400 W, (iii) an analysis of the power scaling of HPT performance.