

Status of the pulsed micro energy propulsion research for nano satellites orientation

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Abstract

Axially ejected plasma jets and plasma shocks have been observed in plasma focus devices, leaving the electrodes at high velocity. For instance, in a plasma focus operating at 400J a plasma of $\sim 10^{-10}$ kg is ejected with a velocity $> 10^5$ m/s. These plasma conditions appear promising to be used as the base of a pulsed plasma thruster (PPT), particularly to develop a miniaturized propulsion device for orientation, capable of being integrated to a small-standardized satellite, such as the Cubesat. According to theoretical and scaling estimations, it is expected that for a pulsed plasma thruster operating with a stored energy of 1 J, a bit impulse in the range of fractions of μ Ns to some μ Ns per pulse would be obtained. This work presents the status of the pulsed micro energy propulsion research for nano satellites orientation developed by the P²mc Research Center of CCHEN and by SPEL of University of Chile. The report includes: a) design, construction and characterization of a miniaturized fast capacitor (2 kV, 2 μ F, ~ 40 nH, ~ 20 kA), b) design and construction of plasma guns with submillimeter internal and external radius, c) electrical characterization of the miniaturized capacitor connected to the plasma gun operated at 1 to 2 J, d) measurements of the capacitor temperature operating at different repetition rate e) discussion and design of possible experimental arrays to measure the force produced by the miniaturized pulsed plasma thruster: optical measurements of the velocity and mass, torsional pendulum and thrust stand based on a single point load cell.

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