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Performance of a Pulsed Plasma Thruster at Low Discharge Energy

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Pulsed Plasma Thruster (PPT) is an electronic propulsion system, in which the plasma is generated in the surface breakdown of solid propellant (PTFE). While the self-induced Lorentz force accelerates the plasma, it produces a thrust which acts in the opposite direction. PPT was established since 1964, research interest in this propulsion system was renewed recently due to the miniature satellites such as the CubeSats. In this work, a PPT with tongue-flared electrode operated at low energy range of 0.5 - 2.5 J was studied. Performance characteristics such as the impulse bit (Ibit), specific impulse (Isp), mass bit (mbit) and thrust efficiency (η) were measured using a torsional thrust stand and these performance parameters are compared to those reported in other PPTs of similar range of discharge energy. Degradation of the solid PTFE propellant is evaluated from the Field Effect Scanning Electron Microscopy (FESEM) imaging and Energy Dispersive X-Ray (EDX) analysis of the PTFE bars after 10,000 discharges. Ibit was found to increase with discharge energy while Isp and η decreased. The thrust efficiency η was higher at the low end of the discharge energy range. This was correlated to less effective expulsion of the ablated PTFE at the lower discharge energy.

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