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Evaluating the Performance of a Pulsed Plasma Thruster Discharged at Low Energies

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The demand for low-cost propulsion systems for next generation of satellites and the development of miniature CubeSat concept have renewed interest on the Pulsed Plasma Thruster (PPT). PPT is a type of electronic propulsion. In PPT, plasma is developed from the surface breakdown at, for example, the Teflon propellant and the self-induced Lorentz force accelerates the plasma to produces a thrust.

Although PPT is an established system in use, the low efficiency of PPT is still a challenging problem to be addressed. The thrust efficiency of PPTs is between 2-8%. One of the factors that affect the efficiency of PPT is the electrode design. Studies have shown that the tongue-shaped electrode with a flare angle is able to increase the performance and thrust efficiency. [1,2]

Most of the PPT are operated at high energy, that is, above 2 J. However, as the size of satellite becomes smaller and smaller, there is a need to study the performance of PPT at low energy range (<2 J).

In this study, a PPT with tongue-flared electrode is investigated at low energy range, with incremental energy steps between 0.5 J to 2.5 J. The performance of this PPT, which include impulse bit (I_{bit}), specific impulse (I_{sp}), mass bit (m_{bit}) and efficiency (η), are measured by a torsional thrust stand. [3] Figure 1 shows the comparison to other PPTs. This work is supported by the Ministry of Science, Technology and Innovation, Malaysia (MOSTI) [eScience Fund 04-02-12-SF0339].

References

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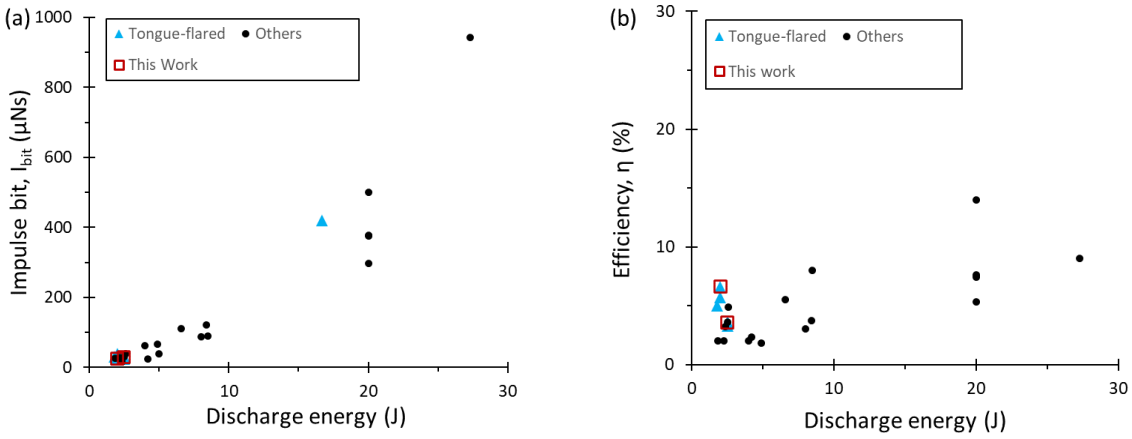

Figure 1. Combined plots of (a) impulse bit and (b) efficiency, for PPTs of both parallel-electrode and tongue-flared parallel electrode configurations at discharge energies up to ~30 J.