Contribution ID: **273** Type: **Poster**

The effect of current rising rate on the deposited energy and light emission intensity characteristic of a capillary based pulsed plasma thruster

Tuesday 20 June 2017 13:30 (1h 30m)

The capillary based pulsed plasma thruster has a huge potential in the small satellite application. It features with higher overall efficiency in low energy level beyond the advantages of traditional pulsed plasma thruster. The typical physical process of the thruster mainly includes discharge, ablation and thrust production. The discharge characteristic reflects the energy transfer efficiency which affects the ablation and thrust production process. In this paper, the effect of current rising rate on the deposited energy, energy transfer efficiency and equivalent circuit parameters and light emission intensity were focused on.

The capillary based pulsed plasma thruster was connected to a low inductance capacitor. The current rising rate could be adjusted conveniently by changing the capacitance of capacitor. In this experiment, the main capacitor was ranged from 1μF to 4.5μF which caused the current rising rate changed from 6kA/μs to 16kA/μs. The results showed that deposited energy decreased with fast current-rate, as well as equivalent plasma resistance. The energy transfer efficiency has the similar tendency. The time-dependent deposited power and energy characteristic were also analyzed.

The light emission intensity characteristic was studied. With the PMT sensor, the time-dependent light emission intensity was measured. It had the similar properties with current waveform. Based on the modified grey-body radiation model, the electron temperature was estimated which was used in the calculation of arc resistance. Moreover, the plasma plume velocity was measured based on the time-flight method with PMT sensors. It showed that the plume velocity could reach 12km/s. More analysis of relation between light emission intensity and discharge characteristic would be conducted.

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Session Classification: Poster session II - Pulsed Power Industrial and Bio-Medical Applications

Track Classification: Pulsed Power Industrial and Bio-Medical Applications