Thrust and Beam Profile Measurements of Indium Field Effect Thrusters

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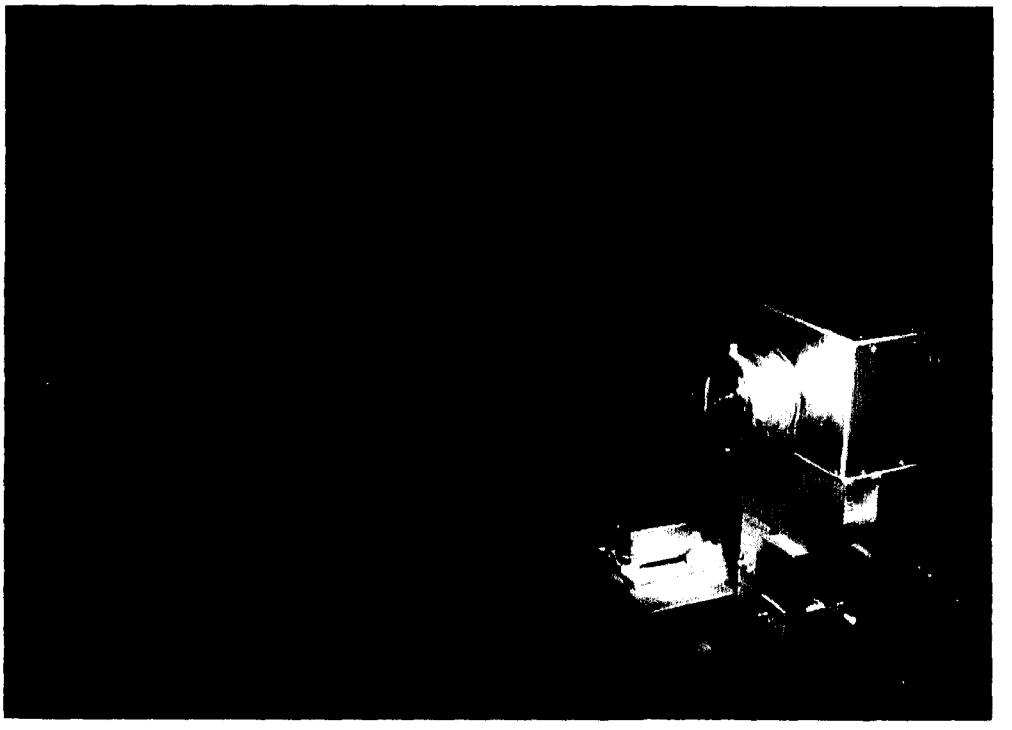
ABSTRACT

The performance of an Austrian Research Center Seibersdorf (ARCS) indium field effect thruster (In-FET) has been measured between 1-100 μN using a submicronewton resolution thrust stand. The In-FET has a single needle geometry emitter and two extractor designs including plate and wire loop geometries, similar to the breadboard In-FET design currently designated for use on the GOCE mission. Thrust has been measured as a function of voltage, V, and beam current, J, and compared to expected thrust based on a beam divergence thrust coefficient, k_{bd},

$$T = 1.54 \times 10^{-3}\ k_{bd}\ J\sqrt{V}\,. \tag{1}$$

The thrust coefficient is seen to decrease from 90% to 80% over the range of 1-10 μN and remain relatively constant at 80% over the rest of the range tested for an emitter to extractor distance of 0.6 mm. At smaller distances, 0.12 mm, the beam is more divergent with a correspondingly lower thrust coefficient, approximately 60% over most of the operational range of the thruster.

To verify direct thrust measurements, a Faraday probe has been used to measure the current density profile of the exhaust beam. The Faraday probe was placed 50 cm from the thruster exit on a 180-degree rotational stage at the same height as the center of the thruster. Normalized profile measurements show the beam is symmetric with a distribution that matches the expected thrust coefficient.