POLYMERIC COATINGS FOR ELECTRODYNAMIC TETHERS

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Two polymeric coatings have been developed for the Propulsive Small Expendable Deployer System (ProSEDS) mission. ProSEDS is designed to provide an on-orbit demonstration of the electrodynamic propulsion capabilities of tethers in space. The ProSEDS experiment will be a secondary payload on a Delta II unmanned expendable booster scheduled for launch in August 2000. A 5-km conductive tether is attached to the Delta II second stage and collects current from the low Earth orbit (LEO) plasma to facilitate de-orbit of the spent stage. The conductive tether is attached to a 10-km non-conductive tether, the other end of which is attached to an endmass containing several scientific instruments.

A bare metal tether would have the best conductivity but thermal concerns preclude this design. A conductive polymer developed by Triton Systems has been optimized for conductivity and thermo-optical properties. The current design for the ProSEDS conductive tether is seven strands of 28 AWG aluminum wire individually coated with 8.7 μm (0.35 mil) of an atomic oxygen-resistant conductive polymer composed of a mixture of 87% Clear Oxygen-Resistant polymer (COR) and 13% polyanaline (PANi), wrapped around a braided Kevlar™ 49 core.

Extensive testing has been performed at the Marshall Space Flight Center (MSFC) to qualify this material for flight on ProSEDS. Atomic oxygen exposure was performed, with solar absorptance and infrared emittance measured before and after exposure. Conductivity was measured before and after atomic oxygen exposure. High voltage tests, up to 1500 V, of the current collecting ability of the COR/PANi have been completed.

Approximately 160 meters of the conductive tether closest to the Delta II second stage is insulated to prevent any electron reconnection to the tether from the plasma contactor. The insulation is composed of polyimide overcoated with TOR-BP, another polymeric coating developed by Triton for this mission. TOR-BP acts as both insulator and a protective coating against atomic oxygen erosion. The insulation has been tested to withstand 5000 V.

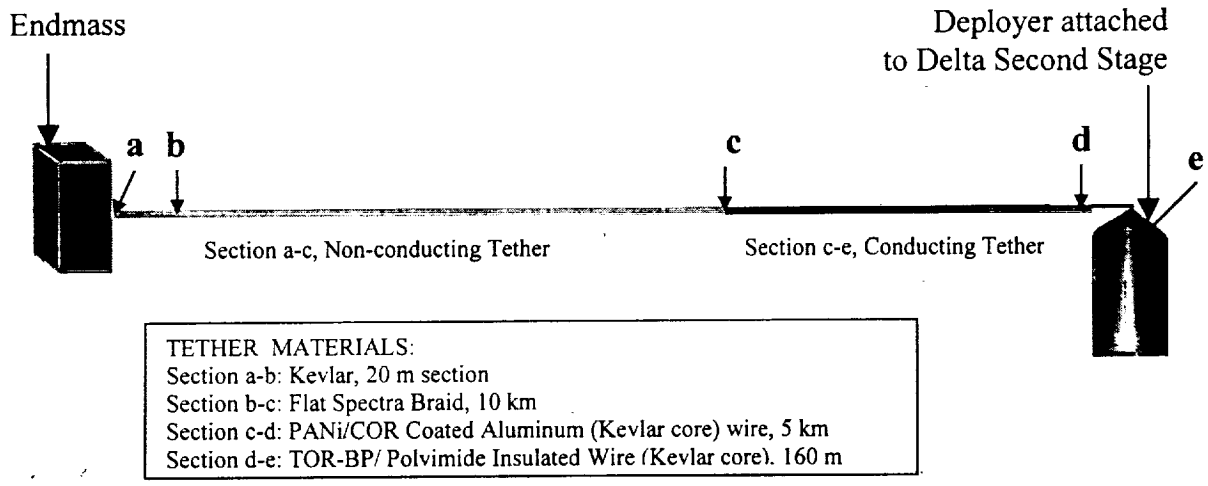

Figure 1. Tether Schematic (not to scale)

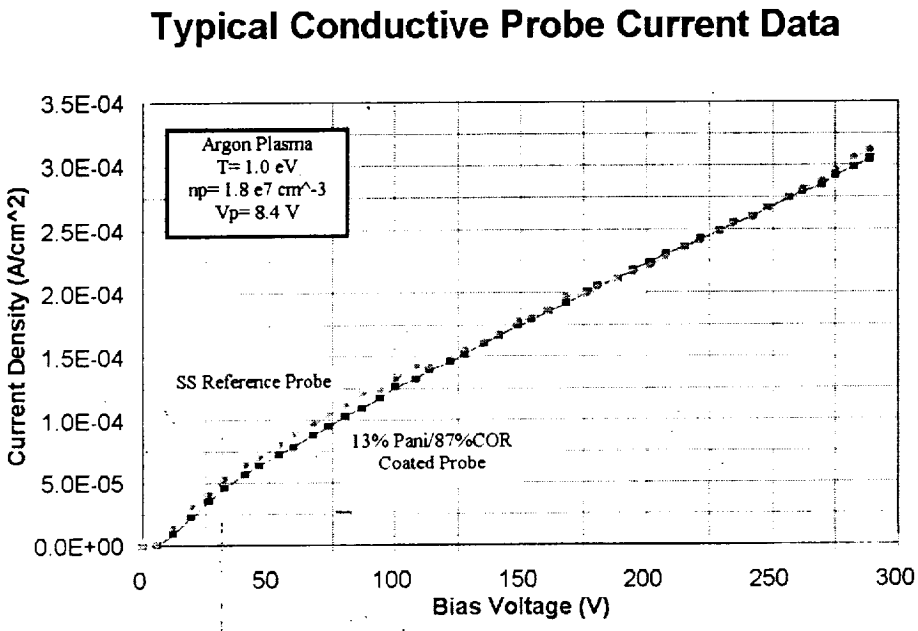

Figure 2