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Embedded miniature thrusters within carbon fiber reinforced structures

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Increased use of carbon fiber reinforced polymers (CFRP) for space applications presents an opportunity of using these structures as a fuel source for thruster operation. Typical CFRP structures used for space applications are designed to handle take-off loading and stresses. This results in an oversized and overweight component in orbit. To take advantage of excess weight an array of electrodes is embedded within and on the surface of CFRP material. Applying high voltage between the electrodes causes the carbon fiber to erode and eject material out of the electrode orifices. Amount of material eroded can be controlled by the supplied current and the duration of the pulses. To maximize the use of material an array of electrodes can cover all of the available surfaces. Doing this also enables rotational control of the spacecraft by firing embedded thrusters on different sides of the spacecraft. Typically 1-4 mN of thrust are possible out of any single electrode orifice and total thrust duration of 10-30 seconds. With approximate size of 10 mm square it is possible to have thousands of electrodes per CFRP panel, depending on size, and with advanced metal electrode printing it would be possible to achieve even tighter packing of electrodes.

Author: Mr NIKIC, Dejan (The Boeing Company)Presenter: Mr NIKIC, Dejan (The Boeing Company)Session Classification: 6.3 Plasma Thrusters

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