Seminar

Institute for Plasma Research

Title : Development of Atomic Oxygen (AO) facility and its effects on Spacecraft Surface Charging

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Date : 10th September 2014, Wednesday

Time : 10.30 AM

Venue : New Building Committee Room No.1, IPR

Abstract:

Spacecraft surface charging can lead to arcing and a loss of electricity generation capability in solar panels or even loss of a satellite. The charging problem may be further aggravated by atomic oxygen (AO) exposure in Low Earth orbits, which modifies the surface of materials like polyimide, Teflon, anti-reflective coatings, cover glass etc, used on satellite surfaces, affecting materials properties, such as resistivity, secondary electron emissivity and photo emission, which govern the charging behavior. These properties are crucial input parameters for spacecraft charging analysis. To study the AO exposure effect on charging governing properties, an atomic oxygen exposure facility based on laser detonation of oxygen was built at KIT, Japan. The AO generation technique used in this study is based on the dissociation of molecular oxygen into AO, originally developed by Caledonia et al., The molecular oxygen is introduced into a previously evacuated expansion nozzle by a fast-acting pulse valve, for which the time open is set to just fill the nozzle with oxygen gas. A pulsed CO_2 laser of 5.5 Joule is then used to break down the gas using a laser-supported detonation (LSD) wave to create high-temperature plasma near the throat region of the nozzle; hence generation of high-velocity AO in an evacuated hypersonic nozzle. The plasma expands down the nozzle as a blast wave, ingesting and dissociating the gas in front of it, ultimately converting the thermal energy into directed velocity. The expansion is tailored so as to allow for electron-ion recombination without atomic recombination. Thus, each laser pulse produces a temporally narrow, high-flux pulse of oxygen atoms at the nozzle exhaust.

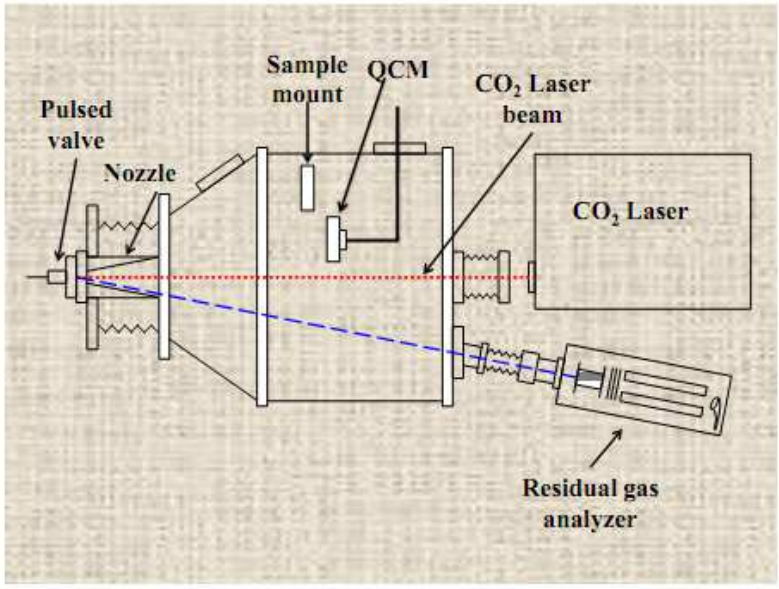

Fig: AO facility