SPACE PROPULSION SYMPOSIUM (C4)
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OVERVIEW OF A HIGH-VOLTAGE MULTI-JUNCTION-CELL CONCENTRATOR ARRAY DIRECT-DRIVING AN ELECTRIC THRUSTER EXPERIMENT

Abstract

Auburn University has performed a "direct drive" demonstration using a high-voltage (600 Voc) ENTECH SunLine concentrator array equipped with III-V multijunction solar cells coupled to a Russian T-100 Hall Effect Thruster (HET). This may well be the first time a Hall thruster has been run directly from III-V-based multi-junction solar cells and at this high voltage. This paper will discuss the set-up and testing results. Testing will include the addition of Stretched Lens Array (SLA) hardware in a vacuum chamber to measure plume impingement effects at various positions relative to the exhaust axis of the thruster.

The goal of this task was to define the most meaningful combined high voltage SLA concentrator array and Hall-effect thruster demonstration tests relevant to solar electric propulsion (SEP) to test SLA reliability and provide information to help advance the SLA's qualification level. This is the next step under a Phase II STTR with NASA Glenn Research Center for the development of SLA hardware for SEP missions and is being performed at Auburn University's Space Research Institute. The SLA developed by ENTECH is a space solar array that uses refractive concentrator technology to collect and convert solar energy into useful electricity. The concentrator uses a stretched Fresnel lens that refracts the incident light onto high-performance multi-junction photovoltaic cells. The ENTECH SunLine triple-junction concentrator array is very similar to the SLA design. While this SLA array technology design has high efficiency, low mass, and radiation-hardness, the SLA must also tolerate plume interactions with the thruster.

SunLine-HET direct-drive runs have been completed successfully. Figure 1 shows multiple views of the T-100 HET plasma discharge while under direct drive power from the ENTECH SunLine PV array. Many other settings during several of the parameter sweeps provided additional information. Testing, data reduction and analysis is ongoing and data charts will be presented to illustrate trends and dynamic behaviors.

Soon SLA test samples will be installed in this test chamber and exposed to the plasma plume shown above. The samples will be placed in different sections of the plume and biased up to 600 VDC to replicate space effects of similar high biases. The results of the successful "direct drive" experiment performed under a range of conditions will be presented along with the durability test results. This test opens the door to new electric propulsion options that have reduced power processing mass.