Thin, Flexible IMM Solar Array

Offering higher efficiencies and lower mass and flexibility

NASA needs solar arrays that are thin, flexible, and highly efficient; package compactly for launch; and deploy into large, structurally stable high-power generators. Inverted metamorphic multijunction (IMM) solar cells can enable these arrays, but integration of this thin crystalline cell technology presents certain challenges. The Thin Hybrid Interconnected Solar Array (THINS) technology allows robust and reliable integration of IMM cells into a flexible blanket comprising standardized modules engineered for easy production. The modules support the IMM cell by using multifunctional materials for structural stability, shielding, coefficient of thermal expansion (CTE) stress relief, and integrated thermal and electrical functions. The design approach includes total encapsulation, which benefits high voltage as well as electrostatic performance.

In Phase I of this project, the THINS design was refined for enhanced environmental durability and integration into a large deployment structure such as Mega Roll-Out Solar Array (Mega-ROSA) or MegaFlex. Phase II advanced the THINS technology, incorporating advanced IMM solar cells into THINS modules and then integrating these modules into the MegaFlex deployable structure where it underwent environmental testing, including launch vibration, thermal vacuum deployment, and electrostatic discharge/plasma testing. The THINS technology is further enhanced by automated manufacturing activities being performed under a Phase II SBIR with NASA, focusing on reducing manufacturing costs and scale-up. This technology is expected to provide tens to hundreds of kilowatts to enable outer planetary missions, allow improved solar electric propulsion performance during cruise, and provide significant power (i.e., hundreds of watts) despite the minimal sunlight available at the asteroid belt, Jupiter, and beyond.

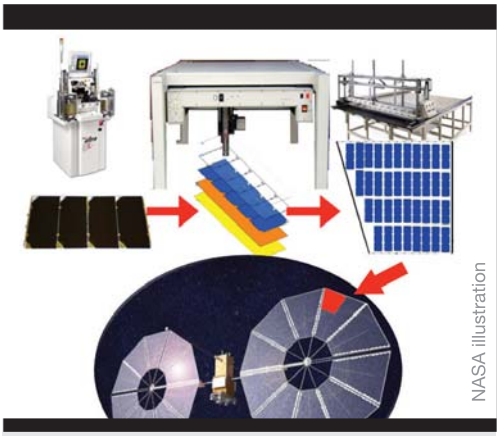
Applications

NASA

- Solar electric propulsion (SEP)
- Electric and magnetic field instruments used on NASA science spacecraft:
  - Time History of Events and Macroscale Interactions during Substorms (THEMIS)
  - Magnetospheric Multiscale (MMS) mission
  - Mars Atmosphere and Volatile Evolution (MAVEN) space probe
  - Direct-drive SEP approaches

Commercial

- Commercial spacecraft



NASA illustration

Phase II Objectives

- Fabricate and performance test a full-scale module
- Test module coupons in the most stressing simulated space environments
- Develop and fabricate a deployment demonstration of a THINS MegaFlex array containing a complete photovoltaic array blanket comprising THINS modules with some active cells
- Demonstrate full-scale deployment at ambient, hot, and cold temperatures

Benefits

- Designed for manufacturability using mature semiconductor industry standard equipment and processes
- Fits tens of kilowatts in a compact stowage envelope
- Improves process control
- Enables smaller, more economical launch vehicles
- Uses total encapsulation and continuity of cover glass materials to create a continuous grounded, shielded enclosure

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Proposal Number: 10-2 X8.04-9431