In-Situ Fabrication of Lunar Solar Cells

Status, Plans, Connections to NASA's Mission and Vision and to the Space Architect's Capability Requirements

Organizing principles

NASA 2003 Strategic Plan

Goal 3
Create a more secure world and improve the quality of life by investing in technologies and collaborating with other agencies, industry, and academia.
- 3.3
- 3.4*

Goal 7
Engage the public in shaping and sharing the experience of exploration and discovery.
- 7.3*

Goal 8
Ensure the provision of space access and improve it by increasing safety, reliability, and affordability.
- 8.6

Goal 9
Extend the duration and boundaries of human space flight to create new opportunities for exploration and discovery.
- 9.5

Goal 10
Enable revolutionary capabilities through new technology.
- 10.4
- 10.6*

* These objectives are reflected in the overall Research Partnership Program and thus not connected to specific requirements of any single research program.

Space Architect Perspective
Capability Requirements

OBPR Organizing Questions

Requirements

Requirement: power supply: lunar surface. In order to power initial lunar bases or mining operations, moon-based energy generating systems are needed.

Requirement: power supply: lunar surface: communications. In order to communicate with other locations such as satellites, Earth, space craft, etc), moon-based energy generating systems are needed.

Requirement: U.S. economy. A strong U.S. economy requires a cheap supply of energy.

Plans

Plans. We will develop the solar cell on the glass regolith substrate, develop the regolith and source material heating system (solar concentrator into fiber optic), design the rover for fabrication of the solar cells and refine the cost analysis.

Hypotheses & Projects

Hypothesis. A lunar rover can be built to fabricate solar cells on the Moon to supply cost effective power for a variety of operations

Project: IN-SITU FABRICATION OF LUNAR SOLAR CELLS

Project description. This project is investigating the fabrication of solar cells directly on the surface of the Moon to provide power to initial lunar bases, mining operations or to be beamed to other locations (satellites, Earth, etc.). The fabrication of solar cells on the Moon would be cheaper than transporting arrays large enough for significant power.

Status: We have found that the lunar regolith can be melted to form a glassy substrate that is suitable for solar cell deposition. We have also performed cost analysis indicating that the solar cells made on the Moon would be less expensive than transporting large arrays. We have also identified a candidate solar cell to be deposited on the Moon and have a preliminary design of a rover to perform the fabrication.

Project site: Texas Center for Superconductivity and Advanced Materials

Research Partnership Centers Multiple Benefits

Immediate applications on Earth. This project would supply power for operations on the Moon or for power beaming elsewhere.

Leverage NASA research funds. NASA CEDTP until March 2003.

Importance. This work will provide a power source for initial operations on the Moon. More power can be added as needed. This will occur in a more cost effective manner than transporting large solar arrays. The power is available for use on the Moon or near the Moon

Knowns and unknowns

Known. The power incident on the Moon from the Sun is 1.36 kW/m2. Even with a solar cell of 10% efficiency (<_ typical terrestrial), significant power could be generated on the Moon (1 square kilometer ~ 1.36 gigawatts). The resources in place on the Moon are conducive to fabrication of the solar cells. There is plenty of real estate to devote to solar farms for supplying energy.

Unknown. We still need to determine the following: optimal solar cell structure and deposition technique, design of heating the regolith to melting temperature and heating of source material for deposition, method on connecting the solar cells into large arrays, finish rover design.

Status: Prototype V.3
MacroVU® Analytics

Horn, R. E. Preliminary Thoughts on NASA Strategic Research

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