Project Introduction

The semiconductor material InAlAs has the potential to improve upon current space photovoltaics in a number of ways. InAlAsSb lattice-matched to InP would operate as the top cell in a triple-junction design with an AM0 efficiency of 37.1%, a cell-level mass specific power >1000 W/kg, and panel-level mass specific power of 662 W/kg. Development of InAlAs for engineered substrates would result in a lattice-matched triple-junction cell with a 1-sun AM1.5 efficiency of 40.4%. Additionally, InAlAs lattice-matched to InP has the appropriate bandgap for operation in low-intensity low-temperature conditions. Development of these proposed photovoltaic cells is particularly warranted since the InP materials system is known to be exceptionally radiation tolerant, which is ideal for space operation. Furthermore, lattice-matched cells are lighter and more mechanically stable than their metamorphic counterparts. The technology proposed in this application would increase capability and durability for missions needing onboard power or electric propulsion, and would also correspond to technology gains for terrestrial concentrator photovoltaic systems. The materials proposed in this study have undergone little to no development. Development of these materials would occur via semiconductor growth methods of metal organic vapor phase epitaxy or molecular beam epitaxy. Growth conditions such as temperature, gaseous precursors, and gas ratios can be adjusted to target desired material properties. This research would initially focus on materials development. Once the desired material are grown, they can then be fabricated in complete photovoltaic cells and tested for radiation and temperature tolerance which are important considerations for space applications.

Anticipated Benefits

This technology could increase capability and durability for missions needing onboard power or electric propulsion, and could also correspond to technology gains for terrestrial concentrator photovoltaic systems.
Primary U.S. Work Locations and Key Partners

<table>
<thead>
<tr>
<th>Organizations Performing Work</th>
<th>Role</th>
<th>Type</th>
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<tbody>
<tr>
<td>Rochester Institute of Technology</td>
<td>Lead Organization</td>
<td>Academic</td>
<td>Rochester, NY</td>
</tr>
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Primary U.S. Work Locations

New York

Organizational Responsibility

- **Responsible Mission Directorate:** Space Technology Mission Directorate (STMD)
- **Lead Organization:** Rochester Institute of Technology
- **Responsible Program:** Space Technology Research Grants

Project Management

- **Program Director:** Claudia M Meyer
- **Program Manager:** Hung D Nguyen
- **Principal Investigator:** Seth Hubbard
- **Co-Investigator:** Brittany Buck

Project Website:

https://www.nasa.gov/directorates/spacetech/home/index.html
Space Technology Research Grants

Development of InAlAs Top Cell for High Specific Power Multijunction Photovoltaics

Completed Technology Project (2015 - 2019)

Technology Maturity (TRL)

Start: 2  
Current: 2  
Estimated End: 3

Technology Areas

Primary:

- TA3 Space Power and Energy Storage
  - TA3.1 Power Generation
    - TA3.1.3 Solar

Target Destinations

Earth, Mars, Others Inside the Solar System

For more information and an accessible alternative, please visit: https://techport.nasa.gov/view/91475