Future Directions for Thin Films in Space Workshop at SPRAT XVIII

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Overview

For approximately ten years, the SPRAT conference series at NASA Glenn (formerly Lewis) Research Center has devoted a workshop to the topic of thin-film solar cell technology and its potential for space applications. While thin-film materials have been investigated for a number of years, including copper sulfide research at NASA in the 1960's, there has been a re-birth of interest in this class of materials for space applications in the past dozen years or so. There are several reasons for this renaissance. An important contributor is efficiency improvements beyond ten percent. Another contributor is the increase in interest represented by funding opportunities by NASA and several agencies in the U.S. Department of Defense (Missile Defense Agency, Air Force, and DARPA). Finally, there have been several intriguing missions identified through various means, these include: station-keeping for high-altitude airships, space solar power, planetary surface power, and solar electric propulsion. To aid in leading the discussion for this workshop, a series of seven questions were posed. These are reproduced below as well as a summary of key points and conclusions from the workshop as well as an attendees list and results of an informal poll related to long-term potential of thin films for space.

Workshop Discussion Questions

1 – Will thin film PV (for space) always be the technology of the future?

2 – Polycrystalline thin film materials co-exist with polymer? Quantum dots? Poly III-V?

3 – How do metal and polymer substrates compare for I-III-VI_2 arrays? Array interconnects?

4 – Effect of operating temperatures (space environment) on TFPV? Self-annealing?

5 – How far can we push polymers? Are there inherent efficiency limiters? Sodium? Deposition/processing temperature? Do we need new balance of system technologies?

6 – Optimal deposition methods? Important device components? Multi-junction structures?

7 – Specific missions for TFPV? Large area? Surface operations? Integrated power? DOD-related missions? Air Force? Commercial?

Issues Raised During Discussions

- Four space PV companies (Sharp; RWE; Emcore; and Spectrolab) but none that focus on TF cells
- Only TF cells (not arrays) have been flown; TF cells shown to be radiation hard
- Question: is radiation hardness a function of low efficiency? Or is it the fact that there is not very much material for reactions to take place
- Difficult to find suppliers for polymer substrates (low volume for applications) most likely will be a small company
- TF development can't rely on literature and research foundation like Si and III-V materials; the basic physics has not yet been developed
- Thin-film development will most likely require government funding; IRAD will not be sufficient for long-term development

Key Conclusion(s) Derived from Discussions

- The prevailing view is that CI(G)S must be deposited on polymer substrates to be a competitive technology
- Thin film on polymer must have an efficiency of at least eight percent AM0 for a large area
- Array technology that is developed must be revolutionary and developed in parallel with cell technology

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Informal Survey

- The workshop attendees were asked an unscientific survey question: **Are you optimistic about the long-term prospects for thin-film technology for space power?**

- **Results:** Yes – 58% No – 21% Uncertain – 21%