Workshop III

Future Directions for Thin Films Workshop at SPRAT XIX

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Overview

The SPRAT conference series at NASA Glenn Research Center has devoted a workshop to the topic of thin-film solar cell technology and potential aerospace applications. With the advent of aerospace applications requiring very-high, mass, specific power, there has been a renewed interest in thin film materials and solar cells. Aerospace applications such as station-keeping for high-altitude airships, space solar power, lunar and planetary surface power, and solar electric propulsion would be enhanced or enabled by the development of flexible, very-high, mass specific power thin film arrays. To initiate discussion, a series of questions were asked of the attendees. These questions, three generated by the group, and the attendees' comments follow.

Workshop Discussion Questions

1 – How does thinned, high-efficiency single-crystal compound semiconductor compare to thin film polycrystalline technologies?
Comments: Thinned, high-efficiency, single-crystal compound semiconductors will be a competitor with thin film polycrystalline semiconductors, but thinned single-crystal is less mature than CIGS. Don't abandon CIGS. Thinned, single crystal could be the better way to go for space; but cost could be the deciding factor and thinned, single-crystal would be expensive. Based upon cost vs. efficiency, high-altitude airship could be a key user of the thinned, high-efficiency, single-crystal solar cells.

2 – Considering the slow space market, is there a terrestrial market in which thin film solar cells on polymer substrates can compete with thin film on metal substrates?
Comments: Monolithic integration is a key technology enabled by the use polymer substrates rather than metallic substates. Monolithic integration reduces the manufacturing cost. Military applications such as battery chargers, tents, etc., use thin film solar cells on polymer substrates, but metal foils substrates also might work for these applications. Between space and high-altitude airships, the potential market may justify the production of thin film solar cells on polymer substrates.

3 – Do the operating temperatures in a space environment significantly differ for thin film PV on polymer substrates compared to metal substrates?
Comments: There is not a significant difference between the operating temperature of thin film solar cells on polymer or metal substrates. Some metals are better than Kapton.

4 – Are monolithic interconnections of any significant benefit for terrestrial applications?
Comments: Yes, monolithic interconnections are a significant benefit for terrestrial applications, not materials costs, but manufacturing cost! The potential for increased rips and tears are a concern for polymer substrates.

5 –With thin film cell level being promised at the >1000W/kg level, do you see near-term array technologies that will maintain the high mass specific power? Far-term?
Comments: Yes, otherwise it is not worth pursuing. Lockheed, Boeing, and AC-Able, have thin film array technology projects. The entire structure needs to be designed from the ground up for thin film solar arrays. Monolithic integration is a key technology for a thin film array. TECSAT2 is designed to take advantage of thin film cells.

Attendee Asked Questions

1- What happened to CdTe?
Comments: CdTe has been hurt by potential environmental concerns and the difficulty of building the CdTe superstrate structure on flexible substrates.

2- Is there enough feedstock of Indium?
Comments: There may not be sufficient indium in the world to go around. Indium is not a primary mining material. It may not be possible to fabricate cells at the TeraWatt level with projected supplies of indium.

3- Is there a connection between those who are building spacecraft and those making thin films solar cells/arrays?
Comments: Yes, the military DSX program and ITN's work with Microsat.

General Comments

1- Maintaining the R&D funding for thin film solar cell technologies is critical. It is necessary to find a customer who wants/needs the technology and is willing to pay the money.

2- MEO applications benefit from the use of CIGS self-annealing reduces/removes the effects of radiation on the cells.

3- CIGS has a high potential for the terrestrial market due to the potential for significantly lower product costs. The terrestrial market drives the solar cell industry.