Crack-Tolerant Advanced Metallization for PV

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Background

Advanced solar cells used in space vehicles today are rapidly moving towards thin-film-based inverted metamorphic multijunction (IMM) cells mounted on flexible substrates. Unfortunately, IMM fracture during packaging or after prolonged cycles of temperature fluctuations encountered in low earth orbit operation. This cell fracture leads to cracks in metal contacts, electrically isolating fractured units and subsequently reducing power generation. These microcracks can electrically disconnect areas of the cells and lead to substantial power loss. There is a present need for technologies that can mitigate power loss and increase the lifetime of IMM cells.

Technology Breakthrough

Researchers at the University of New Mexico and Air Force Research Laboratory have developed a novel technology for mitigating stress-induced metal line fractures in thin-film solar cells. The unique metal matrix composite (MMC) films maintain electrical conductivity upon mechanical fracture of the substrate. Strain failure tests show that conductivity is maintained up to 42-μm wide microcracks in the composite layer, where composite lines are capable of bridging cracks in the underlying semiconductor substrates. In addition, the composite materials show "self-healing" characteristics, where the electrical connection gets re-established when the fractured gap narrows. This "self-healing" behavior of MMC gridlines is an important characteristic due to the extreme temperature fluctuations encountered in space operations, in which the PV cells undergo constant expansion and contraction.

Key Advantages

- *Demonstrated that technology is capable of maintaining electrical connection to the fractured substrates despite 10s of micrometer wide fracture gaps*
- *Self-healing capabilities*
- *Improved performance, conductivity, and longevity*
- *Applications in solar/photovoltaic cells*
- *Transferrable to terrestrial silicon-based solar cells*

Intellectual Property

Filed PCT Application: PCT/US2016/038197
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