Nanorod Antireflection Coatings Improve Quantum Dot Solar Cells

Supporting/Contributing Agency: National Reconnaissance Office

This R&D combines the results of two successful nanotechnology programs to pursue a vastly improved solar cell for space applications.

Rensellear Polytechnic Institute (RPI) in collaboration with Rochester Institute of Technology (RIT) is developing a revolutionary solar cell with a nano-structured antireflection coating (ARC) to extend the spectral conversion range for multi-junction solar cells and is verifying their suitability for space use. This collaboration initiated when researchers from RPI created the world's first material that reflects virtually no light. The nanorod material's 10x reduction in reflectance compared to conventional solar cell cover glass opened the door to improving solar cell efficiency by several percent. Combining this nano-scale filament technology with the RIT Quantum Dot Solar Cell R&D offers the opportunity to exceed the World record for monolithic space solar cell efficiency by achieving efficiency up to 46%.

R&D success to date include:

- Researchers at RPI fabricate nanoscale filaments made of either silicon dioxide or titanium dioxide on III-V solar cells provided by RIT
- RIT optically characterizes the as-produced coatings and their impact on cell spectral response
- RIT made a comparison of these coatings with standard MgF and ZnS coating produced at RIT on sister cells

Figure 1 below shows scanning electron micrograph (SEM) of the RPI nanorod anti-reflective coating. Figure 2 shows a 16% improvement in short-circuit current density with the RPI nanorod anti-reflective coating applied to a solar cell. Research in this area continues in an effort to maximize the solar cell design and performance gains from the combination of these two nanotechnologies.

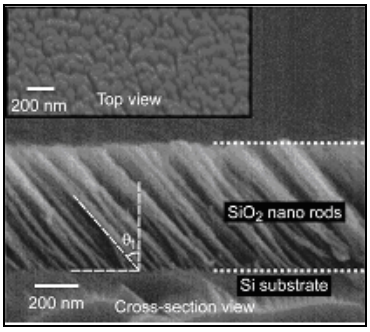

Figure 1. Cross-sectional views of a SEM for a SiO_2 nanorod layer

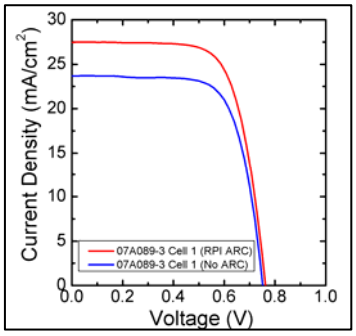

Figure 2. Current density versus voltage profile showing a 16% improvement with the RPI ARC

References/Publications

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Chhajed S., Schubert M. F., Kim J. K., Schubert E. F., Nanostructured Multilayer Graded-Index Antireflection Coating For Si Solar Cells With Broadband And Omnidirectional Characteristics, Applied Physics Letters 93, 251108 (2008).

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