NREL Highlights

SCIENCE

Harmful Shunting Mechanisms Found in Silicon Solar Cells

NREL scientists develop near-field optical microscopy techniques for imaging solar cell junctions and identify critical electrical breakdown mechanisms.

Junction breakdown at low reverse bias is an increasingly important issue for silicon solar cells. The issue has taken center stage now that the solar industry is moving toward the production of low-cost, solar-grade silicon, which contains higher concentrations of impurities. NREL's Measurement and Characterization (M&C) team examined local junction breakdown in silicon solar cells by using near-field scanning optical microscopy (NSOM) and electroluminescence (EL) imaging techniques to identify the processes responsible for this degradation mechanism.

The NSOM techniques use an extruded small-diameter optical fiber to probe the surface to obtain high-resolution topography and forward- and reverse-bias electroluminescence data. This allows researchers to resolve, at the microscale, the location and spatial distribution of the breakdown voltage. The M&C team developed this advanced instrumentation for the characterization of junction breakdown in solar cells and identified the microstructural defects responsible for the degradation in open-circuit voltage and high dark currents in epitaxial silicon solar cells. The technique is also applicable to other PV technologies such as CIGS and CdTe thin-film devices. The M&C team provided feedback to NREL's industrial partners on the critical shunting mechanisms operating in their cells—and the manufacturing processes and issues that cause them.

Reference: M.J. Romero et al. "Nanoscale Measurements of Local Junction Breakdown in Epitaxial film Silicon Solar Cells. *Appl. Phys. Lett.* **97**, 092107 (2010).

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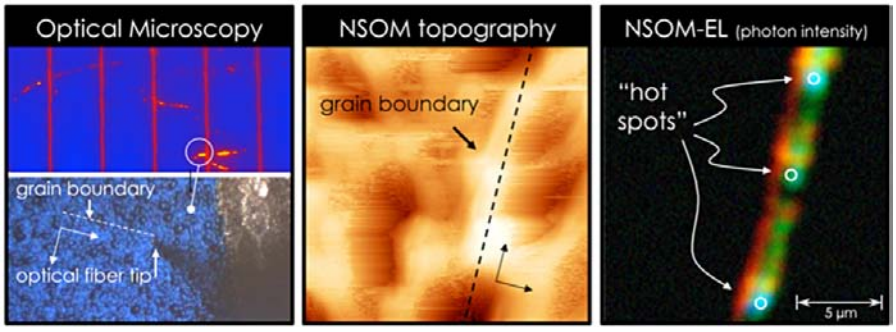

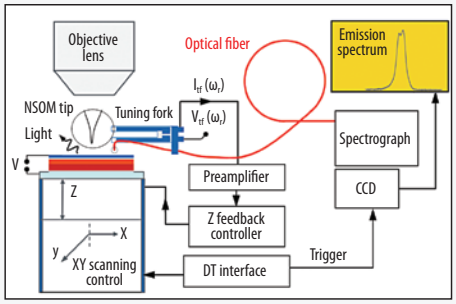

Key Research Results

Achievement

NREL's Measurement and Characterization team examined local junction breakdown in silicon and thin-film solar cells by electroluminescence imaging and developed a scanning probe technique to resolve the processes involved.

Key Result

NREL scientists identified the microstructural defects responsible for junction degradation and provided feedback to industrial partners on the manufacturing processes and issues that cause them.

Potential Impact

Solar cell producers are facing urgent pressures to lower module production cost. This achievement is likely to make a significant improvement to the production yield, which is a key parameter in lowering module production cost and meeting the goals of the U.S. Department of Energy's SunShot Initiative.

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