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NATIONAL RENEWABLE ENERGY LABORATORY

NREL Collaboration Breaks 1-Volt Barrier in CdTe Solar Technology

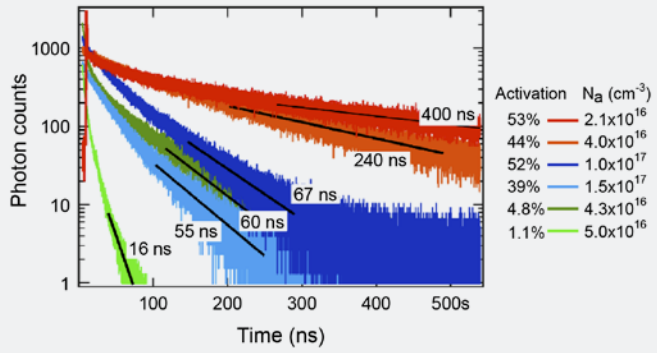
Highlights in Research & Development

Reaching a critical voltage milestone provides path for CdTe solar technology to undercut electricity costs from traditional sources.

Cadmium telluride (CdTe) solar cells offer a low-cost alternative to silicon cells, while also having the lowest carbon footprint and adapting better to real-world conditions. However, until recently, CdTe solar cells have been less efficient than silicon-based cells.

The lower efficiency relates to underperformance in the parameter of maximum voltage available from the solar cell. For the past 60 years, poor CdTe material properties have prevented industry and universities from obtaining more than 900 millivolts over a huge number of solar cells. In fact, the vast majority have been limited to 750 to 850 millivolts.

But working with Washington State University and University of Tennessee researchers, National Renewable Energy Laboratory (NREL) scientists have significantly improved the material, leading to CdTe solar cells with a maximum or open-circuit voltage breaking the 1-volt barrier for the first time.



Time-correlated single-photon counting decay curves showing lifetime of photo-excited electrons in the research team's bulk CdTe as a function of hole density and activation levels, which are each two to three orders of magnitude better than those in traditional CdTe solar devices. Illustration by NREL.

The research team improved cell voltage by shifting away from a standard processing step using cadmium chloride. Instead, researchers placed a small number of phosphorus atoms on tellurium lattice sites and then carefully formed ideal interfaces between materials with different atomic spacing to complete the solar cell. This approach improved the CdTe conductivity and carrier lifetime each by orders of magnitude—which enabled breaking the 1-volt barrier.

This innovation establishes new paths for CdTe solar cells to provide electricity at lower cost than that generated by fossil fuels.

Technical Contact: Wyatt Metzger, wyatt.metzger@nrel.gov

References: J.M. Burst et al., "CdTe solar cells with open-circuit voltage breaking the 1V barrier," *Nature Energy* 16015 (2016). DOI: 10.1038/nenergy.2016.15

Key Research Results

Achievement

NREL scientists have worked with Washington State University and the University of Tennessee to improve the maximum voltage available from CdTe solar cells.

Key Result

Changes in dopants, stoichiometry, interface design, and defect chemistry improved the CdTe conductivity and carrier lifetime by orders of magnitude, thus enabling CdTe solar cells with open-circuit voltages exceeding 1 volt for the first time.

Potential Impact

Values of current density and fill factor for CdTe solar cells are already at high levels, but sub-par voltages has been a barrier to improved efficiencies. With voltages pushed beyond 1 volt, CdTe cells have a path to produce electricity at costs less than fossil fuels.

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

15013 Denver West Parkway
Golden, CO 80401
303-275-3000 | www.nrel.gov

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