

# Study advances understanding of photoelectrodes

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Scientists at the Energy Department's National Renewable Energy Laboratory (NREL) have developed a new probe that could lead to a better photoelectrochemical cell.

A paper on the discovery, 'Semiconductor interfacial carrier dynamics via photoinduced electric fields,' was published in *Science* magazine.

Ye Yang and Jing Gu are lead authors of the paper. NREL colleagues, James Young, Elisa Miller, John Turner, Nathan Neale and Matthew Beard also contributed to the research.

Photoelectrochemical cells can be used to convert solar energy into transportable chemical fuels. The photoconversion process employs a semiconductor photoelectrode where photoexcited electrons move to the surface of the electrode to drive chemical reactions, such as reduction of water to produce hydrogen.

As the charges move, fields are formed within the photoelectrode. The NREL team developed a spectroscopic [probe](#) that for the first time allows the formation and decay of these fields to be monitored directly.

The NREL researchers used the new probe to better understand the photophysics of photoelectrodes made from the semiconductor gallium-indium-phosphide (GaInP<sub>2</sub>). Previous work at NREL used GaInP<sub>2</sub> as part of a high-efficiency [water splitting](#) system to generate hydrogen from sunlight. By using the newly developed probe, the scientists

uncovered the role that a titanium dioxide (TiO<sub>2</sub>) / GaInP<sub>2</sub> interface plays in the photoconversion process.

The new measurement tool could lead to improvements in how photoelectrodes are designed to make them more efficient and more stable.

Additional research is needed, including the incorporation of a catalyst on the surface of the TiO<sub>2</sub>, where this technique can be used to understand the role of the catalyst in the hydrogen production reaction.

**More information:** Y. Yang et al. Semiconductor interfacial carrier dynamics via photoinduced electric fields, *Science* (2015). [DOI: 10.1126/science.aad3459](https://doi.org/10.1126/science.aad3459)

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