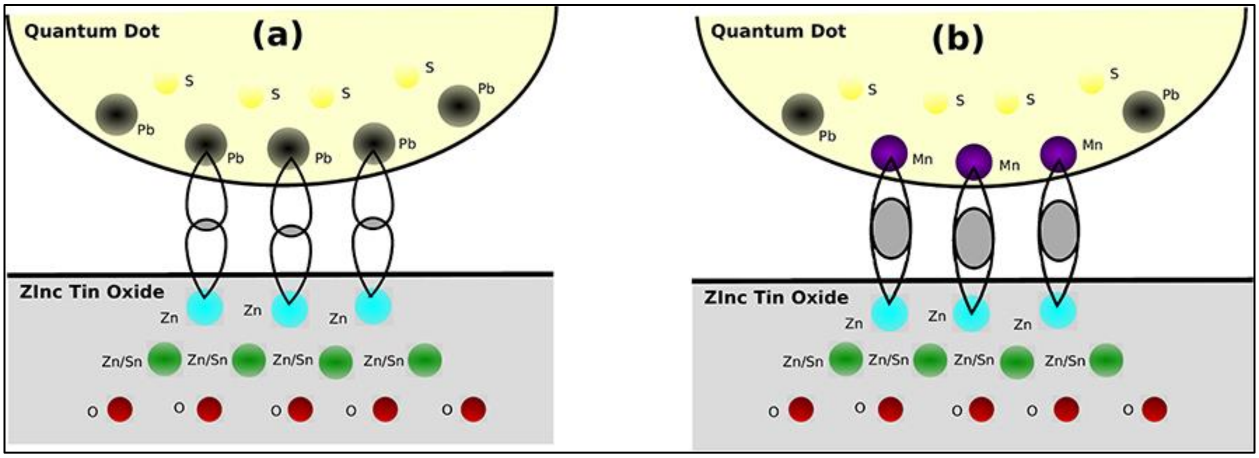
Technical Assistance Request
Until now, most improvements in the efficiency of conventional photovoltaic cells have been incremental. However, large efficiency improvements can be accomplished by using the extra energy in higher energy photons to produce extra photocurrent rather than just heat the panels. Additionally, upconversion of lower energy photons not absorbed by the PV panels can be upconverted to photons of higher energy that can contribute to the photocurrent. Quantum confined semiconductor nanocrystals, or so-called quantum dots, can be utilized to accomplish both processes that would produce large jumps in the efficiency of photovoltaic devices.

We have partnered with two research groups from the University of Wyoming that are developing and fabricating these quantum dot techniques. Specifically, research in the Parkinson group showed for the first time that photocurrent yields can be doubled at energies greater than twice the bandgap of pbS quantum dots[1]. The Parkinson group is also working on upconversion of infrared photons to higher energy electron-hole pairs in nanocrystals of the new perovskite semiconductor $CsPbBr_3$ [2].

The Tang group works on novel methods for producing quantum dots for enhanced photovoltaic conversion; they work on engineering unique interface structures between the quantum dots and photoanode that foster efficient electron transfer for advanced solar cells. The quest for more efficient solar cells has led to the search for new materials. For years, scientists have explored using tiny drops of designer materials, called quantum dots. The Tang Research Group has discovered that adding small amounts of manganese decreases the ability of quantum dots to absorb light while increasing the current produced by an average of 300%. Under certain conditions, the current produced increased by 700%. The enhancement is due to the faster rate that the electrons move from the quantum dot to the balance of the solar cell (known as the electron tunneling rate) in the presence of the manganese atoms at the interface. This work was funded and supported by the U.S. Department of Energy, Office of Basic Energy Sciences, as part of the Experimental Program to Stimulate Competitive Research (EPSCoR) program[3].



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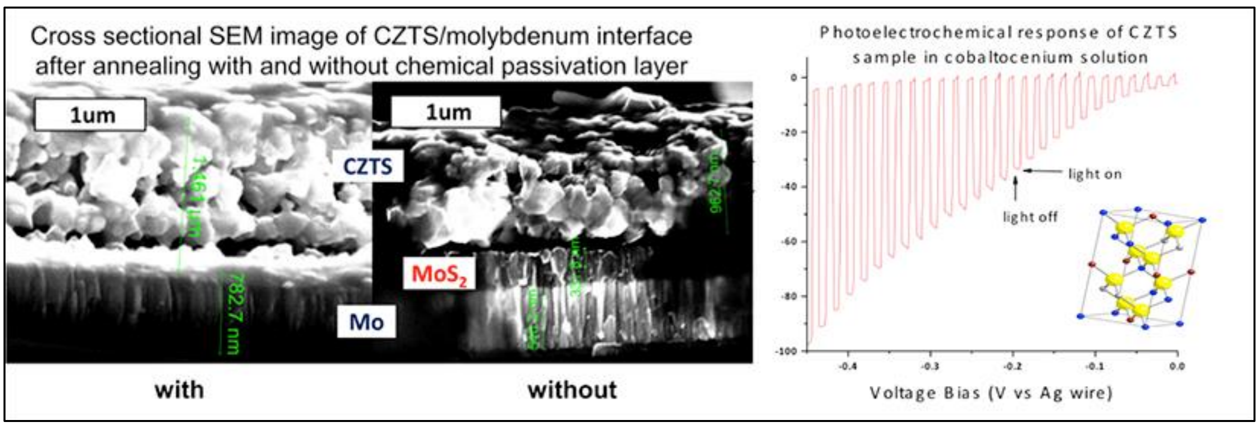

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We are requesting guidance and assistance from National Laboratories, private facilities, and members of the AmericanMade Network to build upon and advance our research in these PV hardware topics.

Thank you for your consideration,

Paul Bonifas
Director of Operations
9H Energy

[1] *Sambur, J. B., Novet, T., & Parkinson, B. A. (2010). Multiple Exciton Collection in a Sensitized Photovoltaic System. Science, 63-66.*

[2] *Parkinson Research Group. (2020). Research. Retrieved from Parkinson Research Group: https://www.uwyo.edu/parkinson/research.html*

[3] *Department of Energy. (2017, February 1). One Small Change Makes Solar Cells More Efficient. Retrieved from energy.gov: https://www.energy.gov/science/bes/articles/one-small-change-makes-solar-cells-more-efficient*