Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

**High Efficiency, Surface Stable Photocatalytic H2 evolution on TiO2-passivated GaAs**[1] JING QIU, GUANGTONG ZENG, University of Southern California, STEPHEN B. CRONIN, STEPHEN B. CRONIN NANO RESEARCH LAB TEAM — III-V compounds, such as GaAs, are used widely for high efficiency photovoltaic solar energy conversion. The electrochemical instability of these materials, however, has limited their applicability in photocatalysis. Here, we demonstrate that thin (1-5nm) films of TiO2 deposited by atomic layer deposition on planar GaAs provide electrochemical stability and substantial improvements in the efficiency of photocatalytic water splitting. The TiO2-passivated GaAs shows no photochemical degradation or corrosion after 48 hours, while bare GaAs shows substantial degradation after just 15 minutes. This TiO2 passivation layer produces a 32-fold enhancement over bare GaAs, with an overall photoconversion efficiency of 11%. We find that just 1nm of TiO2 produces the optimum conditions for photocatalysis. This is not thick enough to form a continuous film, and instead produces small regions of non-stiochiometric TiOx, which is rich with Ti3+ surface states that are known to be catalytically active sites. These charged sites stabilize, or lower the energy of, OH- intermediate species in this reaction, thus lowering the reaction barrier height. X-ray photoemission spectroscopy and photoluminescence spectroscopy provide further evidence for these Ti3+ surface states.

[1] ARO award No. W911NF-14-1-0228 & NSF Award No. CBET-0846725, XPS data were collected at the Molecular Materials Research Center of the Beckman Institute of the California Institute of Technology.

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Date submitted: 13 Nov 2014 Electronic form version 1.4