Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Nanoporous Hydrogen-Reduced $BiVO_4$: better charge separation with Ni-B_i Electrocatalysts for Photoelectrochemical Water Oxidation JIAYONG GAN, YUEBING ZHENG, Department of Mechanical Engineering, Materials Science and Engineering Program, and Texas Materials Institute, The University of Texas at Austin — $BiVO_4$ as a photoanode material has attracted broad attention recently as an inexpensive and robust semiconductor for potential application for solar water oxidation. However its photochemical activity is limited by poor charge carrier separation. Here we show that this problem can be solved by constructing a nanoporous morphology as well as controlled introduction of oxygen vacancies via hydrogenation. In comparison to pristine $BiVO_4$, the hydrogen-treated $BiVO_4$ (H-$BiVO_4$) show superior photocurrent and electron-hole separation yield of 0.95 at 1.23 V vs. reversible hydrogen electrode (RHE) due to enhanced carrier density and conductivity. Significantly, we adopt a layer of nickel-borate (Ni-B_i) complex on the $BiVO_4$ surface as an oxygen evolution catalyst. Modification of H-$BiVO_4$ photoanode with Ni-Bi has yielded a large ($\sim$300 mV) cathodic shift in the onset potential at pH 7. It shows an outstanding performance in the low bias region and the maximum power point for solar water oxidation was achieved at potential as low as 0.75 V vs. RHE with a photocurrent density of 2.25 mA/cm^2. We attribute these improved PEC performances to the enhanced charge separation, carrier density and conductivity in these photoanodes.

Yuebing Zheng
Department of Mechanical Engineering,
Materials Science and Engineering Program, and
Texas Materials Institute, The University of Texas at Austin

Date submitted: 15 Nov 2014 Electronic form version 1.4