Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Optoelectronics, Theory and Defect Physics of Zn-IV Nitride Semiconductors PRINEHA NARANG, California Institute of Technology, SHIYOU CHEN, Joint Center for Artificial Photosynthesis, AASHRITA MANGU, California Institute of Technology, JASON COOPER, SHERAZ GUL, JUNKO YANO, LIN-WANG WANG, Lawrence Berkeley National Laboratory, NATHAN LEWIS, HARRY ATWATER, California Institute of Technology — $ZnSn_xGe_{1-x}N_2$ alloys with optical band gaps ranging from 2-3.1eV can be tuned to span a large portion of the solar spectrum, and could therefore be a viable earth-abundant light absorber and replacement for InGaN in nitride optoelectronic devices. They exhibit local order as demonstrated via X-ray absorption fine structure spectroscopy (EXAFS) and a linear relationship between the (002) peak position and composition in XRD studies. The bowing parameter is 0.29 eV for the measured band gaps of $ZnSn_{1-x}Ge_xN_2$, significantly smaller than that of $In_{1-x}Ga_xN$, indicating that the $ZnSn_{1-x}Ge_xN_2$ alloy band gaps can be tuned almost linearly by controlling the Sn/Ge composition. In this presentation we show theoretical studies of the optoelectronic behavior and defect physics of $Zn(Sn,Ge)N_2$ series and experimental investigations via X-ray absorption and emission spectroscopy to probe the conduction and valence-band partial density of states. Band structure calculations from different methods will be shown in comparison with the experimental optical properties. Resonant inelastic scattering studies of the $Zn(Sn,Ge)N_2$ lattice will be presented with their carrier dynamics obtained from pump-probe spectroscopy.

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Date submitted: 14 Nov 2013 Electronic form version 1.4