Andrew B. Yankovich et al., J Material Sci Eng 2012, 1:3
http://dx.doi.org/10.4172/2169-0022.S1.004

OMICS Group Conferences
Accelerating Scientific Discovery

International Conference and Expo on
Materials Science & Engineering

October 22-24, 2012 DoubleTree by Hilton Chicago-North Shore, USA

p-Type conduction in ZnO nanowires from Sb-Decorated Head-to-Head basal plane inversion domain boundaries

Andrew B. Yankovich, B. Puchala, Fei Wang, Jung-Hun Seo, D. Morgan, Xudong Wang Alex V. Kvit, Zhenqiang Ma and Paul M. Voyles
University of Wisconsin Madison, USA

Like many compound semiconductors, ZnO suffers from the doping asymmetry problem, where it is intrinsically n-type and extremely difficult to dope p-type. p-type ZnO would enable a variety of p-n homojunction based optoelectronic devices. A variety of acceptor doping and co-doping schemes based on Group V elements have been investigated, but reproducible and stable p-type ZnO remains elusive. We have synthesized Sb-doped ZnO NWs using a solution synthesis technique. A single NW field effect transistor shows the ZnO NWs have p-type conduction that is stable over 18 months at room temperature. Aberration-corrected Z-contrast scanning transmission electron microscopy (STEM) imaging and density functional theory (DFT) calculations reveals that all of the Sb in the NWs is incorporated into Sb-decorated head-to-head (H-H) basal-plane inversion domain boundaries (b-IDBs) just under the (0001) NW growth surfaces and the (0001) bottom facets of interior voids. The predominant H-H nature of the b-IDBs are stabilized by the presence of associated internal voids that maintain the Zn-polarity of the NW. The Sb H-H b-IDBs stabilize an extra plane of O in the structure, effectively co-doping the nanowires with Sb and O. DFT calculations show the extra plane of O in H-H IDBs act as electron acceptors, making the ZnO NWs p-type. This new mechanism for p-type conduction in ZnO provides potential for ZnO NW based p-n homojunction devices.

Biography

Andrew B. Yankovich is pursuing his Ph.D. in Materials Science and Engineering at the University of Wisconsin in Madison. He has spoken at conferences such as Microscopy and Microanalysis 2011 in Nashville TN and SPIE Photonics West 2011 in San Francisco CA. He has published more than 5 journal papers and conference proceedings, including a paper in Nano Letters this year on the work presented at this conference.

ayankovich@wisc.edu