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Axial Si/Ge hetero-nanowires for tunneling transistors SON LE, Department of Physics and School of Engineering, Brown University, DANIEL PEREA, Environmental and Molecular Sciences Laboratory, Pacific Northwest National Laboratory, POOYA JANNATY, XU LUO, Department of Physics and School of Engineering, Brown University, SHADI DAYEH, Department of Electrical and Computer Engineering, University of California, ALEXANDER ZASLAVSKY, Department of Physics and School of Engineering, Brown University, THOMAS PICRAUX, Center for Integrated Nanotechnologies, Los Alamos National Laboratory
— Modern vapor-liquid-solid (VLS) growth based on alloy catalysts can grow SiGe heteronanowires (hetero-NWs) with controlled axial heterojunction abruptness [1] combined with simultaneous control of material composition (Si and Ge) and doping profile. Previously, we reported on axial in-situ doped Ge NW pn junction tunneling field effect transistors (TFETs) with effective backgate control of the tunneling current [2]. In this presentation, we report on tri-gated p-Ge/i-Si/n-Si axial hetero-NWs TFET with on-state tunneling occuring in the Ge drain section and off-state leakage dominated by the Si junction in the source. The devices have high Ion of 2 uA/um, suppressed ambipolarity, and a sub-threshold slope SS of 140 mV/decade over 4 decades of current with lowest SS of 50 mV/decade. Device operation in the tunneling mode is confirmed by three-dimensional TCAD simulation. In addition, our devices work standard as NW FETs with good Ion/Ioff ratio when the source-drain junction is forward-biased [3]. [1] D. E. Perea et al., Nano Lett 11, 3117 (2011). [2] Son T. Le et al., Appl. Phys. Lett. 96, 262102 (2010). [3] Son T. Le et al., accepted to Nano Lett. (10/2012).

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