Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Electrical transport and structural characterization of epitaxial monolayer MoS_2 /n- and p-doped GaN vertical lattice-matched heterojunctions D RUZMETOV, T O'REGAN, US Army Research Laboratory, K ZHANG, Pennsylvania State University, A HERZING, NIST, A. MAZZONI, M. CHIN, ARL, S. HUANG, University of Arizona, Z. ZHANG, UA, R. BURKE, M. NEUPANE, AG BIRDWELL, P. SHAH, F. CROWNE, ARL, A KOLMAKOV, NIST, B. LEROY, UA, J. ROBINSON, PSU, A. DAVYDOV, NIST, T. IVANOV, ARL — We investigate vertical semiconductor junctions consisting of monolayer MoS_2 that is epitaxially grown on n- and p-doped GaN crystals. Such a junction represents a building block for 2D/3D vertical semiconductor heterostructures. Epitaxial, lattice-matched growth of MoS_2 on GaN is important to ensure high quality interfaces that are crucial for the efficient vertical transport. The MoS_2/GaN junctions were characterized with cross-sectional and planar scanning transmission electron microscopy (STEM), scanning tunneling microscopy, and atomic force microscopy. The MoS_2/GaN lattice mismatch is measured to be near 1% using STEM. The electrical transport in the out-of-plane direction across the MoS_2/GaN junctions was measured using conductive atomic force microscopy and mechanical nanoprobes inside a scanning electron microscope. Nano-disc metal contacts to MoS_2 were fabricated by e-beam lithography and evaporation. The current-voltage curves of the vertical MoS_2/GaN junctions exhibit rectification with opposite polarities for n-doped and p-doped GaN. The metal contact determines the general features of the current-voltage curves, and the MoS_2 monolayer modifies the electrical transport across the contact/GaN interface.

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Date submitted: 30 Nov 2016 Electronic form version 1.4