Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Ferroelectric Tunnel Junction with a Semiconductor Electrode

XIAOHUI LIU, J.D. BURTON, EVGENY TSYMBAL, University of Nebraska-Lincoln — Realizing a large tunneling electroresistance (TER) is crucial for the application of ferroelectric tunnel junctions (FTJs) for device applications. FTJs are typically composed of a thin ferroelectric layer sandwiched by two metallic electrodes, where TER generally results from the dependence of the effective tunneling barrier height on the ferroelectric polarization. Since the resistance depends exponentially not only on barrier height but also on barrier width, TER is expected to be greatly enhanced when one of the electrodes is a semiconductor where the depletion region near the interface can be controlled via ferroelectric polarization. To explore this possibility, we perform studies on a SrRuO3/BaTiO3/n-SrTiO3 FTJ using first-principles density functional theory (DFT). We analyze the effect of ferroelectric polarization on the barrier width and transport properties. Our studies show that, in addition to modulation of the depletion region in n-SrTiO3, layers in the BaTiO3 barrier near the interface become conducting for one polarization orientation leading to a large TER effect. Additional DFT+U calculations reveal that this effect is insensitive to the bandgap of the barrier, indicating that this should be a robust mechanism to realize large TER in FTJs.

Xiaohui Liu
University of Nebraska-Lincoln

Date submitted: 06 Nov 2015 Electronic form version 1.4