Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Pyroelectric Control of Rashba Spin-Split States and Spin-Relaxation Times in a GaN/InN/GaN Topological Insulator PARIJAT SENGUPTA, Purdue University — Strong spin-orbit coupling leading to band inversion in bulk is necessary for creation of topological insulator states (TI). Electric field can also be used to invert the band structure. Nitrides in wurtzite phase possess an internal electric field due to spontaneous and piezoelectric polarization which is sufficient to invert the band-ordering of a narrow-gap InN. A TI state exists in a thin-film of InN sandwiched between GaN layers. For a certain quantum well thickness, inversion of bands happen at a threshold value of the polarization field. Polarization fields are controlled by selecting a facet orientation of the quantum well layer determined by the dominant polarization mechanism. Additionally, at a finite k-vector, the Rashba-induced spin-splitting on the surface of this heterostructure is computed. The splitting under a first-order approximation is independent of k-vector and corresponds to the polarization field's contribution to the Rashba coefficient. Finally, the interplay of mechanisms that control spin-relaxation times is used to design a spin transistor. An enhancement in the lifetime of the spin-polarized states under certain growth conditions is observed due to mutual cancelation the Rashba and Dresselhaus splitting to suppress spin-relaxation.

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Date submitted: 15 Nov 2013 Electronic form version 1.4