Abstract Submitted
for the MAR06 Meeting of
The American Physical Society

Complete non-equilibrium spin polarization of electrons in degenerate semiconductors A. G. PETUKHOV, Physics Department, South Dakota School of Mines and Technology, Rapid City, SD, V. V. OSIPOV, V. N. SMELYANSKIY, NASA Ames Research Center, Moffett Field, CA — We show that spin polarization of electrons in nonmagnetic degenerate semiconductors near specially tailored forward- biased ferromagnet-semiconductor junctions can achieve 100%. This effect is realized even at moderate spin polarization of the interfacial contact resistance. Our conclusions are based on detailed analysis of non-linear spin diffusion equation with realistic boundary conditions. The effect of complete spin extraction occurs at relatively strong electric fields and arises from a reduction of spin penetration length due to the drift of electrons from a semiconductor towards the spin- selective tunnel junction. We further demonstrate that non- equilibrium electrons in thin nonmagnetic semiconductor layers can be almost fully spin polarized by means of simultaneous electrical spin injection and extraction. The complete spin polarization is achieved if the thin layer is placed between two ferromagnetic metal contacts with moderate spin injection coefficients and antiparallel magnetizations. The sign of the spin polarization is determined by the direction of the current. Applications of this effect in spintronics and quantum information processing are discussed.

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Date submitted: 30 Nov 2005 Electronic form version 1.4