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Model for the Bias Dependence of the Sign of Spin Injection in Ferromagnetic Metal/Semiconductor Schottky Tunnel Contacts P.P. RUDEN, University of Minnesota, D.L. SMITH, Los Alamos National Laboratory — We examine theoretically the spin-polarized electron injection across a ferromagnetic metal/semiconductor Schottky tunnel barrier. The example structures we model consist of thin, heavily doped regions near an Fe/GaAs interface in which the band bending associated with the Schottky barrier is accommodated, and lightly doped bulk regions.[1,2] Under reverse bias electrons tunnel from the Fe through the space charge layer into the lightly doped region; under forward bias electrons tunnel from the GaAs into the Fe. Because Fe is ferromagnetic, the transmission is spin-dependent. The shape of the tunnel barrier depends strongly on bias. By considering the asymptotic forms of the wave functions, we show that the bias dependence of the spin-dependent transmission coefficients generally can induce a change in the sign of the spin-polarized current. Model calculations reveal that spin-polarized transport is sensitive to the tunnel barrier properties. The results are in good agreement with recent experimental data. 1) A.T. Hanbicki et al., Appl. Phys. Lett. 80, 1240 (2002). 2) S.A. Crooker et al., Science 309, 2191 (2005).

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