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Spin Injection and Relaxation in Ferromagnet-Semiconductor Heterostructures X. LOU, C. ADELMANN, J. STRAND, C. J. PALMSTRØM, P. A. CROWELL, University of Minnesota — We present a detailed description of spin injection and detection in $Fe/Al_xGa_{1-x}As/GaAs$ heterostructures for temperatures from 2 to 295 K. Experimental measurements of the full bias and temperature dependence of the steady-state spin polarization in the semiconductor indicate three distinct temperature regimes for spin transport and relaxation. At temperatures below 70 K, spin-polarized electrons injected into quantum well (QW) structures form excitons, and the spin polarization in the QW depends strongly on the electrical bias conditions as well as the temperature. At intermediate temperatures, the spin polarization is determined primarily by the spin relaxation rate for free electrons in the QW. This process is slow relative to the spin relaxation rate for excitons at lower temperatures and is responsible for a broad maximum in the spin polarization between 100 and 200 K. The spin injection efficiency of the $Fe/Al_xGa_{1-x}As$ Schottky barrier decreases at higher temperatures, although a steady- state spin polarization of at least 6% is observed at 295 K. The difference in spin relaxation effects between QW and bulk systems is also investigated over the full bias and temperature range.

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