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Spin accumulation in Fe/MgO/Si heterostructures[1] A.T. HANBICKI, O.M.J. VAN 'T ERVE, S.-F. CHENG, R. GOSWAMI, C.H. LI, G. KIOSEOGLOU, P.E. THOMPSON, B.T. JONKER, Naval Research Laboratory — We report on spin injection experiments at Fe/MgO/Si interfaces using all electrical injection and detection. MgO is a promising magnetic tunnel junction material, and its incorporation with Si-based spintronics has only recently been reported in degenerately doped Si (n $\sim 10^{20} cm^{-3}$) [1]. We focus here on spin accumulation under the injecting contact for much lower n-doping levels by measuring the Hanle effect in a standard 3-terminal scheme where injection and detection are done using the same contact. The Fe/MgO spin injector was sputter deposited onto various n-doped Si bulk substrates using a variety of different substrate temperatures. The best tunnel barriers were obtained when the MgO was deposited at 70°C and annealed $in-situ$ before Fe deposition. Fits to Hanle curves using the drift-diffusion model for Si samples with n=$4x10^{18} cm^{-3}$ yield spin lifetimes $\tau_s = 0.28$ ns up to 30 K and a spin diffusion length $L_s=\sqrt{D\tau_s}$ of 0.65 μm (the diffusion constant D is obtained from the mobility assuming degenerate statistics). We determine the dependence on n, and comment on the potential differences between SOI and bulk Si wafer transport channels. [1] T. Sasaki, et al., Appl. Phys. Exp. 2 (2009).

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