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Electrical spin injection into Si(001) through a SiO_2 tunnel barrier C.H. LI, G. KIOSEOGLOU, O.M.J. VAN 'T ERVE, P.E. THOMPSON, B.T. JONKER, Naval Research Lab — We recently demonstrated successful injection of spin-polarized electrons from an Fe film through an Al_2O_3 tunnel barrier into Si (001) [1]. However, the utilization of SiO_2 as the spin tunnel barrier can prove technologically important owing to the prevalence of SiO_2 and the SiO_2/Si interface in the CMOS industry. Here we demonstrate spin polarized tunneling from Fe through a SiO_2 tunnel barrier into a Si $n-i-p$ heterostructure [2]. Transport measurements indicate an effective barrier height of ∼1.7 eV and barrier thickness of ∼21 Å for 10 K, and that single step tunneling is the dominant transport mechanism. The electroluminescence from the Si exhibits circular polarization that tracks the Fe magnetization, confirming electrical injection from Fe. A rate equation analysis provides a lower bound of 30% for the electron spin polarization in the Si at 5 K. These results demonstrate that an ultra thin layer of SiO_2, readily fabricated on Si through UV-ozone oxidation, can be used as a viable tunnel barrier for electrical spin injection from a ferromagnetic contact into Si.

[1] B. T. Jonker et al., Nature Phys. 3, 542 (2007); G. Kioseoglou et al., APL 94, 122106 (2009).
[2] C. H. Li et al. APL 95, 172102 (2009).

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