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All-epitaxial heterostructure for tunneling spins into silicon
MAITRI WARUSAWITHANA, DARRELL SCHLOM, Department of Materials Science and Engineering, Penn State University., XIANGLIN KE, PETER SCHIFFER, Department of Physics, Penn State University. — An all-epitaxial spin-tunnel structure has been constructed using molecular-beam epitaxy (MBE). The structure consists of an epitaxial layer of iron (∼100 Å thick) on commensurately strained $SrTiO_3$ (∼20 Å thick) on (100) Si. The thin $SrTiO_3$ layer serves simultaneously as a tunnel barrier for spin polarized currents and as a protective layer preventing the reaction between iron and the underlying silicon which would lead to the formation of an undesired iron silicide. While the iron film was grown in ultra high vacuum, the growth of the $SrTiO_3$ film on silicon was accomplished using molecular oxygen via a sequence of steps by which the formation of an interfacial amorphous silicon dioxide layer is kinetically suppressed. Magnetic measurements indicate strong magnetic anisotropy with the easy axis lying in the plane of the film and a curie temperature above 400 K. Electrical measurements probing spin injection and detection in microfabricated Fe-$SrTiO_3$-Si-$SrTiO_3$-Fe devices, where the ferromagnetic electrodes have different coercive fields due to size anisotropy, will be discussed.

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