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All Epitaxial Heterostructure for Spin Injection from a Half Metal into Silicon MAITRI WARUSAWITHANA, DARRELL SCHLOM, Department of Materials Science and Engineering, Penn State University, JAMES ECKSTEIN, Department of Physics, University of Illinois at Urbana-Champaign — Using reactive molecular-beam epitaxy, epitaxial $La_{0.7}Sr_{0.3}MnO_3$ / $SrTiO_3$ / Si heterostructures have been grown. The $SrTiO_3$ layer, just a few unit cells thick, serves simultaneously as a tunnel barrier and as a means to reduce reaction between the $La_{0.7}Sr_{0.3}MnO_3$ and the underlying Si. The growth of $La_{0.7}Sr_{0.3}MnO_3$ at MBE-compatible pressures requires ozone, which readily oxidizes bare Si and would destroy the chances for epitaxial growth. In contrast, epitaxial $SrTiO_3$ can be grown on (001) Si using molecular oxygen via a complex, but established process. Once the $SrTiO_3$ film is complete, ozone is turned on for the $La_{0.7}Sr_{0.3}MnO_3$ growth. The thin $SrTiO_3$ layer acts as a diffusion barrier for oxygen limiting the formation of SiO_2 at the $SrTiO_3$/Si interface. X-ray diffraction measurements show that the $La_{0.7}Sr_{0.3}MnO_3$ layer has good crystalline quality with rocking curve full width at half maximum values of the 200 peak of less than 0.5°. Furthermore, electrical transport measurements indicate that the $La_{0.7}Sr_{0.3}MnO_3$ layer is ferromagnetic and metallic below $\sim$370 K with a resistivity $<$100 $\mu\Omega$–cm at 4.2 K. Possible devices for tunneling spins into Si and for detecting spin carrier density inside a Si channel will be discussed.

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