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Fabrication of Encapsulated H-Passivated Si(111) Surfaces for 2D Electron Systems R. N. MCFARLAND, K. ENG, B. E. KANE, University of Maryland at College Park — H-passivated silicon surfaces may provide an excellent high-mobility substrate for 2-D electron systems (2-DES) and, potentially, atomic-scale quantum devices. We have prepared H-Si (111) surfaces *ex situ* using NH_4F and incorporated these atomically flat surfaces into novel field effect devices. Using Si-SiO_2 contact bonding, we encapsulate the H-Si (111) surface in a vacuum cavity, which both isolates the surface from the environment and provides a dielectric through which we can gate electrons. However, successful bonding requires both surfaces being bonded to be atomically flat (rms roughness < 0.5 nm). We have observed that making ohmic contact to the 2-DES via P implantation into the Si (111) affects the surface flatness where significant height variations are created at the contact boundaries due to differential oxidation and etch rates between doped and undoped Si regions. Such topographical irregularities can inhibit contact bonding. Using AFM, we have studied these topographic features on our device surfaces, and report methods for obtaining an overall rms surface roughness < 0.2 nm and for reducing the doping-induced height difference to ≤ 0.5nm by controlling implantation, annealing, and etching parameters. Finally, we discuss ongoing work and the possible implications for quantum computing architectures.

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