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Effect of Substrate Doping in Relaxed SiGe Buffers on Strained Si 2DEG Quantum Devices KUN YAO, MIKHAIL GAEVSKI, Princeton University, ALEXANDER CHERNYSHOV, LEONID ROKHINSON, Purdue University, CURTIN MIKE, JI-SOO PARK, JAMES FIORENZA, ANTHONY LOCHTEFELD, AmberWave Systems, JAMES STURM, Princeton University — We describe the impact of Si substrate doping on the substrate leakage in strained Si two-dimensional electron gases (2DEG) on SiGe relaxed graded buffers and on quantum devices fabricated from the 2DEG. The best commercially available high quality SiGe relaxed buffers with 30% Ge content, grown at temperature above 1000°C, have very low threading dislocation density (<1E5cm^{-2}). Subsequent strained Si/SiGe heterostructures were grown at 625-700°C in a rapid thermal chemical vapor deposition (RTCVD). However, it is shown that the substrate doping (Arsenic) contributes to leakage current origin in relaxed buffers at liquid helium temperatures if the starting Si substrate is heavily doped ($\sim$5E17cm^{-2}). The leakage can be attributed to enhanced dopant diffusion along misfit dislocations and high diffusion rate of As in SiGe. The leakage current makes side gating of nanostructures in the 2DEG impossible. With a lightly doped substrate, to avoid leakage, we achieved a high quality 2DEG and successful side gating of a 2DEG quantum dot for a quantum point contact. This work is supported by the NSA under ARO contract number W911NF-05-1-0437.

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