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Electron Spin Relaxation in Si/SiGe Quantum Dot Ensembles
RYAN M. JOCK, J.-H. HE, A.M. TYRYSHKIN, S.A. LYON, Princeton University, C.-H. LEE, S.-H. HUANG, C.W. LIU, National Taiwan University — Single electron spin states in Si/SiGe quantum dots have shown promise as qubits for quantum information processing. Our previous ensemble microwave measurements of electron spins in gated Si/SiGe quantum dots have displayed relaxation (T_1) and coherence (T_2) times of 250 μs at 350 mK. These experiments used conventional X-band (10 GHz) pulsed Electron Spin Resonance (pESR), on a large area, double-gated, undoped Si/SiGe heterostructure, in which holes with a 300 nm diameter and 700 nm period were lithographically defined in the lower gate. Quantum dots were electrostatically induced in a natural Si quantum well, with their confinement potential controlled by the gates. Electron spin coherence in these first generation quantum dot devices was observed to be T_1-limited at stronger confining potentials. By tailoring the quantum dot size and spacing we can modify the electron confinement barrier and electron wave function size, helping us probe the mechanisms limiting coherence in silicon quantum dots. We will report results on dots with lithographic diameters of 150 to 300 nm and a 375 to 700 nm period. The device with smaller dots and larger spacing displays an extended electron relaxation times (T_1 = 1-2 ms) at 350 mK. Furthermore, we observe a T_2 of 310 μs, that is neither T_1-limited nor temperature dependent. This narrows the field of possible coherence limiting mechanisms, which will be discussed.

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