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MOSFET-like single electron transistor built in pure silicon G.M. JONES, B.H. HU, C.H. YANG, Department of Electrical and Computer Engineering, University of Maryland at College Park, M.J. YANG, Naval Research Laboratory — Solid state implementations of qubits offer the advantage of being scalable, and, in particular, those based on semiconductors can be integrated by existing technologies. The two Zeeman states of an electron spin in a quantum dot (QD) provide a promising candidate for a qubit, and lateral quantum dots provide the best opportunity for scaling. Spins in lateral QDs in the GaAs/AlGaAs single electron transistors (SETs) have been intensively investigated. In contrast, Si provides a number of advantages, including long spin coherence time, large g-factor, and small spin-orbit coupling effect. However, isolation of a single electron in a Si QD has not yet been achieved. We will report a fabrication technique that utilizes the established MOSFET concept on highly resistive Si substrates in order to minimize the potential disorder resulting from impurities. In our approach, 2D (or 1D) electrons are induced by a top gate, which laterally overlaps with the ion-implanted source/drain, but vertically separated by SiO2. Several side gates buried in the SiO2 help define the tunneling barriers and control the number of electrons in the island. We will discuss the operating principle, computer simulation, and experimental results that confirm the validity of the design concept.

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