Si Qubit fabrication must be optimized to minimize defects and produce clean quantum dots and barriers for donor devices. Control of the process is critical when evaluating various designs and working to minimize the impact of each process step. SAND2009-4749C **Characterization of oxide quality with C-V and mobility measurements assists in optimization of the device fabrication processes as well as providing quantitative estimates of the defects, which provides guidance to design and modeling efforts. Correlating these measurement results with specific fabrication steps enables iterative process improvements and the creation of a stable process flow. We examine the impact of several process steps, including poly-Si etch, top gate metallization, 2nd dielectric deposition, and various anneals, and study approaches to pinhole elimination with the goals of high mobility, low defect devices that can be routinely manufactured.**

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