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Optimization of Silicon Nitride Films For Use in Phase Qubits¹ ADAM J. SIROIS, Univ. of Colorado, NIST-Boulder, MARTIN E. HUBER, Univ. of Colorado - Denver, KEVIN D. OSBORN, JOSHUA A. STRONG, RAYMOND W. SIMMONDS, NIST-Boulder — The lifetime (coherence time) of superconducting phase qubits is currently severely limited by lossy materials used in standard fabrication techniques. In particular, the insulator material - typically Silicon Nitride - used to isolate and physically separate different layers of the qubit is of interest. We have conducted a fractional factorial design experiment to optimize SiNx loss properties with respect to several deposition parameters in an Electron Cyclotron Resonance (ECR) Plasma-Enhanced Chemical Vapor Deposition (PECVD) reactor. Our experimental design included a three-level, four-parameter matrix with N2/SiH4 ratio, microwave power, rf power, and pressure as the parameters. The test-bed for these films is a low temperature microwave LC resonator circuit in which the various insulator films are used as the dielectric between a parallel plate capacitor and the Q (Quality Factor) of the circuit gives the relevant loss information for qubit operations.

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