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Josephson Phase Qubits Incorporating Novel Coherent Materials

U. PATEL, Y. GAO, D. HOVER, G. RIBEILL, S. SENDELBACH, R. MCDERMOTT, University of Wisconsin, Madison — The Josephson phase qubit is an attractive candidate for scalable quantum information processing in the solid state; however, qubit coherence is currently limited by coupling to spurious microscopic defects in the materials used to realize the circuit. Here we demonstrate that the incorporation of crystalline, defect-free dielectrics into the circuit leads to a dramatic enhancement of energy relaxation times. In addition we describe the realization of improved superconductor-insulator interfaces with extremely low levels of excess low-frequency flux noise, and we discuss efforts to incorporate these interfaces into the qubit circuit in order to extend pure dephasing times. We describe qubit fabrication and tomographic characterization and discuss ultimate limits to qubit coherence.

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