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Crystalline Josephson phase qubits with improved performance JEFFREY KLINE, SEONGSHIK OH, National Institute of Standards and Technology, HAOHUA WANG, JOHN MARTINIS, U.C. Santa Barbara, DAVID PAPPAS, National Institute of Standards and Technology — One of the greatest challenges in the development of a practical solid-state quantum computer is to overcome decoherence due to coupling between the environment and the qubit. Superconducting quantum computers based on Josephson phase qubits are susceptible to decoherence due to charge noise in both the tunnel barrier and crossover insulators. We have demonstrated that the usage of crystalline tunnel barriers greatly reduce the density of spurious charge fluctuators in the tunnel barrier when compared to the ubiquitous amorphous barrier. However, a performance gain in coherence time was not realized due to decoherence in the crossover insulator. In the latest generation of devices, we have optimized both the tunnel barrier and crossover insulator materials. Low temperature measurements performed on a large area (50 μm^2) device yielded a coherence time of 500 ns which is tied for the Josephson phase qubit world record. We expect increased performance in future generation devices where small area (13 μm^2) junctions will be used.

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