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**Epitaxial growth of $Mo/Al_2O_3/Mo$ trilayers for Josephson junction qubits** JEFFREY S. KLINE, KRISTINE M. LANG, SEONGSHIK OH, KEVIN D. OSBORN, RAYMOND W. SIMMONDS, National Institute of Standards and Technology, ROBERT MCDERMOTT, JOHN M. MARTINIS, University of California-Santa Barbara, DAVID P. PAPPAS, National Institute of Standards and Technology — The growth of ultrathin epitaxial $Al_2O_3$ tunnel barriers on Re has been proven to reduce the number of spurious resonators in Josephson phase qubits when compared to qubits fabricated with amorphous tunnel barriers. Other refractory metals might also be used as base layers for epitaxial $Al_2O_3$ growth. In this work, Mo films were deposited onto $Al_2O_3$ $(11\bar{2}0)$ substrates by UHV magnetron sputtering. To achieve epitaxy, the substrate was held at elevated temperature during the deposition. Post-deposition high temperature anneals increase the terrace size and occurrence of step-bunching as observed by STM. Ultrathin films of $Al_2O_3$ were then deposited at room temperature onto the Mo base layer by reactive evaporation of Al in a controlled oxygen background. A high temperature anneal in an oxygen background crystallizes the amorphous $Al_2O_3$ layer. Finally, the structure is capped with polycrystalline Mo by sputter deposition at room temperature. Dielectric loss measurements on LC oscillators fabricated from these structures will be reported.

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