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Lift-Off Processing and Superconducting Circuit Coherence C.M. QUINTANA, A. MEGRANT, A. DUNSWORTH, ZIJUN CHEN, B. CHIARO, R. BARENDS, B. CAMPBELL, YU CHEN, E. JEFFREY, J. KELLY, J.Y. MUTUS, C. NEILL, P.J.J. O'MALLEY, P. ROUSHAN, D. SANK, J. WENNER, T.C. WHITE, A.N. CLELAND, JOHN M. MARTINIS, UC Santa Barbara — As superconducting circuit coherence continues to increase, careful attention must be paid to device fabrication techniques. Substantial evidence points to dielectric loss from two-level state defects in thin amorphous interfacial regions as a limiting relaxation mechanism for superconducting qubits. Transmon qubits have traditionally been fabricated using lift-off aluminum deposited together with their Josephson junctions; however, improved coherence times have recently been found in transmons which use lift-off metal for only a small fraction of the qubit. To better understand this improvement and predict any remaining limits imposed by the incorporation of lift-off, we characterize the increased loss found in coplanar waveguide resonators formed with lift-off metal. We vary surface treatment such as oxygen ashing and ion milling, and study the effects of double-angle evaporation, e-beam resist residue, and surface roughness on resonator quality factors.

Christopher Quintana
UC Santa Barbara

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