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Minimal resonator loss for circuit quantum electrodynamics RAMI BARENDS, UC Santa Barbara, N. VERCRUYSSEN, A. ENDO, P.J. DE VISSER, T. ZIJLSTRA, T.M. KLAPWIJK, Delft University of Technology, P. DIENER, S.J.C. YATES, J.J.A. BASELMANS, SRON Netherlands Institute for Space Research, H. WANG, M. HOFHEINZ, J. WENNER, M. ANSMANN, R.C. BIALCZAK, M. LENANDER, E. LUCERO, M. NEELEY, A.D. O'CONNELL, D. SANK, M. WEIDES, A.N. CLELAND, J.M. MARTINIS, UC Santa Barbara — In Josephson quantum information processing superconducting coplanar waveguides are used as memory elements and coupling buses. Quality factors of these resonators reach up to a million at high excitation powers, but decrease down to below 100x10^3 at the single photon level in the presently used materials, such as Al and Nb. We report quality factors of up to 500x10^3 by using NbTiN or Re and removing the dielectric from regions with high electric fields. Using a model-analysis and by a comparison with Ta, the crucial sources of intensity-dependent loss are dielectrics on the surface of the metal and substrate. Our approach shows that using non-oxidizing superconductors such as Re and NbTiN and removing dielectrics is a straightforward route to high quality factors in the single photon regime.

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