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Anomalous thickness dependence of quality factor in TiN film resonators grown on functionalized Si substrates PENG XU, TIM KOHLER, Laboratory for Physical Sciences, EVGENIYA LOCK, Naval Research Laboratory, YANIV ROSEN, ARUNA RAMANAYAKA, SAMARESH GUCHHAIT, KEVIN OSBORN, Laboratory for Physical Sciences — Various properties affect the quality factor of superconducting resonators at millikelvin temperatures including the presence of nanoscale interfacial dielectric films and residual quasiparticles. Superconducting titanium nitride is polycrystalline such that growth phases may also affect the resonator quality. Here, we functionalize Si substrates in different hydrophobic and hydrophilic plasma environments, sputter titanium nitride on top and pattern the latter films into resonators. For each functionalization we study the quality factor dependence on the superconducting film thickness, where the thicknesses are changed only between 25 and 50 nm. As expected, most functionalizations reveal very little quality factor dependence on superconducting film thickness. However, other functionalizations dramatically, and even anomalously, increase or decrease the quality with thickness. For example, oxygen plasma functionalization causes the quality factor to increase by a factor of more than ten at single photon power with increased thickness. We report on the progress towards finding the intrinsic reason for strong quality factor dependences on surface functionalization.

Peng Xu
Laboratory for Physical Sciences

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