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Quality factor analysis of surface-passivated cavities at low gradients applying two level system models

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The native oxides of niobium cause surface losses during cavity operation arising from two-level systems/defects (TLS). These losses dominate the quality factor at low accelerating gradients (Eacc < 0.1 MV/m). In particular, the amorphous Nb2O5 is identified as a prominent host for the TLS. Nb2O5 dissociates when the material is baked above 200 ℃ for several hours in vacuum (the so-called Mid-T Bake), allowing for the modification or reduction of these losses. However, due to the inevitable exposure to air after the annealing, the surface reoxidizes and Nb2O5 regrows. When the cavity is already coated with Al2O3 or Ta2O5 and then subjected to the Mid-T Bake, this subsequent reoxidation of the niobium is inhibited.

It is still unclear how the TLS losses are modified when the surface undergoes a passivating coating, and this study aims at possibly finding a correlation between the different passivating layers.

Herein, we studied the quality factor of several superconducting radio frequency cavities in the low gradient range (Eacc < 0.1 MV/m) at 1.5 K and analyzed the data using TLS models like the standard TLS model and the non-interacting TLS (one species and two species). Specifically, we used cavities that had undergone the standard "European XFEL"treatment, followed by an atomic layer depositing coating with a passivating layer and the subsequent Mid-T Bake.

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Yes

Footnotes

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