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The Collaborative Effects of Intrinsic and Extrinsic Impurities in Low RRR SRF Cavities

Sunday, 7 May 2023 16:00 (2 hours)

The superconducting radio-frequency (SRF) community has shown that introducing certain impurities into high-purity niobium can improve quality factors and accelerating gradients. We question why some impurities improve RF performance while others hinder it. The purpose of this study is to characterize the impurity profile of niobium with a low residual resistance ratio (RRR) and correlate these impurities with the RF performance of low RRR cavities so that the mechanism of impurity-based improvements can be better understood and improved upon. The combination of RF testing and material analysis reveals a microscopic picture of why low RRR cavities experience low temperature-dependent BCS resistance behavior more prominently than their high RRR counterparts. We performed surface treatments, low temperature baking and nitrogen-doping, on low RRR cavities to evaluate how the intentional addition of oxygen and nitrogen to the RF layer further improves performance through changes in the mean free path and impurity profile. The results of this study have the potential to unlock a new understanding on SRF materials and enable the next generation of SRF surface treatments.

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Footnotes

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Yes

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