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Impact of initial cold work on the bulk microstructure and flux expulsion performance of SRF Nb cavities

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Recent advances in understanding the subsurface microstructure and microchemistry of niobium (Nb) have led to significant improvements in the quality factor (Q0) of superconducting radiofrequency (SRF) cavities. Beyond traditional surface treatments, emerging evidence highlights the critical role of the bulk microstructure, particularly in influencing the trapping and expulsion of residual magnetic flux during cooldown. We explore the possibilities to change the bulk microstructure by deep-drawing high-purity, cold-rolled Nb sheets into half-cells and fabricating cavities. Notably, forming half-cells starting with a cold-worked Nb sheet prior to heat treatment yields a more uniform and homogeneous microstructure, which correlates with enhanced flux expulsion and improved Q0. In this work, we systematically investigated the effects of varying degrees of cold work followed by heat treatment, on the microstructural evolution of SRF-grade Nb. We also demonstrate the feasibility of fabricating cavities from these cold-worked Nb sheets and assess their flux expulsion behavior. The results demonstrate that tailoring the initial deformation state of Nb offers a promising pathway to consistently optimize SRF cavity performance.

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Yes

Footnotes

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Author: CHETRI, Santosh (Florida State University)

Co-authors: KHANAL, Bashu (Old Dominion University); CARL, Matthew (ATI Specialty Alloys & Components); LANNOY, Nathan (ATI Specialty Alloys & Components); DHAKAL, Pashupati (Thomas Jefferson National Accelerator Facility); LEE, Peter (Florida State University); BALACHANDRAN, Shreyas (Florida State University); BORITZ, Trent (Florida State University)

Presenter: CHETRI, Santosh (Florida State University)

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