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The effects of strain path and strain magnitude on the uniformity of recrystallization in high-RRR niobium 1.3 GHz half-cells

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The consistent production of high-RRR Nb cavities for superconducting radiofrequency applications is critical to advancements in accelerator performance and technology. Despite standard guidelines for material and cavity production, the properties and performance of these cavities can vary significantly. Improvements in cavity performance due to better flux expulsion are observed after heat treatment temperatures in the range of 900-1000℃. This can be attributed to more recrystallization (Rx) and grain growth that removes geometrically necessary dislocations (GNDs) that act as magnetic flux pinning centers. Recent work has shown that the observed Rx fraction via electron backscatter diffraction (EBSD) analysis of GNDs in cold-rolled high-RRR Nb to be strain path dependent. A high-RRR deep-drawn Nb half-cell was sliced with section edges aligned 0°, 45°, and 90° from the final rolling direction of the Nb sheets. The effects of heating rate (5 and 250℃/min), annealing temperature (800 and 900℃), strain path, and strain magnitude on the Rx fraction and uniformity were quantitatively assessed in samples from the iris, equator, and a lesser-strained region in between. The insights gained from these microstructural observations can guide novel heat treatment strategies that enable consistent higher-performance cavity production.

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Yes

Footnotes

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