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The influence of rolling direction and surface pinning of deformed grain boundaries during recrystallization in high-RRR niobium sheet

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The ability to accurately and consistently quantify the recrystallized (Rx) microstructure of heat-treated high-purity Nb used in superconducting radiofrequency (SRF) applications is critical for the improvement of material processing and cavity production. The production of SRF cavity half-cells by deep-drawing Nb sheets into the half-cell geometry results in different stain paths in different locations of the cavity (which includes prior rolling history). Cavity production typically removes the damaged surface layer followed by a vacuum anneal at 800℃ for 3-hours. Dislocation substructures that develop during the anneal are known to be sources of magnetic flux trapping, and higher temperature anneals between 900 and 1000℃ have shown cavity performance improvement through the reduction of these defects. As the microstructure within each lot of Nb varies, it is possible that rolling coupons in different directions could identify differences in Rx response with respect to the rolling direction and provide guidance for the optimal anneal for a given lot. The significance of the strain path effect is exaggerated on the surface due to pinning of deformed grain boundaries during the anneal. Removal of surface grains reveals a more homogeneous Rx with larger grain sizes. Hence, it is critical for the SRF community to understand where measurements are taken (surface vs. interior) to accurately quantify the extent of Rx present in the material.

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Yes

Footnotes

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