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Mechanical characterization of large grain niobium sheets for high-velocity forming of SRF cavities

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The reduced price of large grain niobium sheets, compared with the standard small grain sheets, can play a significant role in cost reduction for the fabrication of superconducting radio frequency (SRF) cavities in large particle accelerators projects. However, the anisotropic properties of the blank hinder its formability with conventional forming techniques, e.g. deep-drawing and spinning. Fast forming technologies such as electro-hydraulic forming and explosive forming might be a good solution to form such highly anisotropic sheets. For this reason, the investigation of large grain niobium properties at high strain rates was performed. Specimens in different crystallographic orientations were cut from a blank for mechanical characterization in tension and compression. Experiments in both stress states for strain rates ranging from 10⁻⁴ to 10³ s⁻¹ were performed to evaluate the strain rate sensitivity and anisotropy of niobium single crystals used in SRF applications. The effect of strain localization and adiabatic heating for the different orientations and strain rates is discussed.

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