Contribution ID: **141** Type: **not specified**

Electro-hydraulic forming of SRF cavities: Effect of strain rate on niobium single crystals

Wednesday 30 June 2021 11:15 (15 minutes)

An investigation of the dislocation substructure and mechanical properties of high-purity niobium single crystals with different initial crystal orientations deformed in tension at strain rates of 10ˆ{-4} to 10ˆ3 sˆ{-1} is presented. Specimens were cut from a large grain niobium disk used for the manufacturing of SRF cavities. Different crystallographic tensile directions exhibited significantly different softening and hardening behaviors and elongation at fracture. Such anisotropy is reduced at high strain rates. Also, different dislocation substructures were observed with TEM at low and high strain rates. At low strain rates, dislocation cells with a high density of long dislocations were observed. At high strain rates, homogeneously distributed dislocations with a higher dislocation dipole density were observed. The relationship between the differences in dislocation substructures and mechanical properties at low and high strain rates and the potential effects on the superconducting properties are discussed.

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Session Classification: EASITrain

Track Classification: EASITrain H2020 Project: EASITrain