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M1Or1A-02: Multiscale Modeling of Polycrystalline Niobium Sheets to Capture Anisotropic Evolution

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An integrated computational model based on a multiscale modeling approach was developed to utilize niobium sheets in forming processes required for high-performance superconducting radio frequency (SRF) cavities. The effects of microstructural features, such as crystalline texture and grain morphology in polycrystalline niobium, on mechanical properties were evaluated based on crystal plasticity. In particular, the influence of microstructural heterogeneity on anisotropy and formability was analyzed. Additionally, the effects of cold rolling and subsequent heat treatment processes on the mechanical properties, including plastic anisotropy, of niobium sheets were investigated. For phenomenological modeling applicable to continuum-scale stamping analysis, a two-yield surface plasticity based combined isotropic-kinematic hardening law was employed to account for the evolution of plastic anisotropy in non-proportional loading conditions.

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