Comparison of Full-Field Crystal Plasticity Simulations to Synchrotron Experiments: Detailed Investigation of Mispredictions

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Abstract

Full-field Crystal Plasticity (CP) simulations are envisaged to strongly complement—if not replace—experiments in the investigation of micro-mechanical material behavior. Before this is achieved, the efficacy of the CP simulations should be tested by comparison against experimental data. The present work is centered around the assessment of the employed full-field CP simulation to reproduce a benchmark experimental data. In particular, an openly accessible dataset pertaining to additively manufactured nickel-based supper alloy characterized by high-energy diffraction microscopy (HEDM) and electron backscatter diffraction (EBSD) experiments is used as the benchmark. The employed material models were calibrated using global tensile stress-strain data and the CP simulations were exactly initialized according to the given initial conditions. The predictions from the CP simulations were juxtaposed against the experimental dataset and were also compared with previous studies on the same dataset. A detailed investigation of agreements and systematic disagreements are presented.

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