In situ Synchrotron X-ray Diffraction Analysis of FCC Metals with Different Stacking Fault Energies Deformed at Room and Cryogenic Temperatures

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The processing of three FCC pure metals with different stacking fault energies was processed by uniaxial tensile tests and characterized by in situ x-ray diffraction, using a synchrotron source, at room and cryogenic temperatures. The tests were performed at the XTMS (X-ray scattering and thermo-mechanical simulation) experimental station and the facility is part of the National Center for Research in Energy and Materials (CNPEM, Campinas, Brazil). The experimental setup used a custom-build thermo-mechanical simulator (Gleeble^{TM} 3S50) integrated with a synchrotron X-ray beamline. The partial inhibition of dynamic recovery due to cryogenic processing allows the reduction of diffraction domains. Thus, the analysis of diffraction patterns was made using the Rietveld refinement, in GSAS software, and parameters such as cristallite size and microstrain were identified. Microscopy techniques were used to obtain fractography images using a Field Emission Gun Scanning Electron Microscopy (FEG-SEM) and the initial conditions of materials using optical microscopy, indicating increasing of the deformation capacity of metals analyzed. The metals tested at cryogenic temperature had much higher resistance and elongation than the materials tested at room temperature, with more dimples at the fracture surface.

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