(NANO-)MECHANICAL PROPERTIES AND DEFORMATION MECHANISMS OF THE TOPOLOGICALLY CLOSED PACKED FE-55MO μ-PHASE AT ROOM TEMPERATURE

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Topologically close-packed (TCP) intermetallic phase precipitates in nickel-base superalloys are assumed to cause a deterioration of the mechanical properties of the γ - γ‘matrix. Although these intermetallic phases are well studied in terms of their structure, their mechanical properties have not yet been investigated in detail due to their large and complex crystal structures and pronounced brittleness. In this study we have chosen the Fe-Mo system as a model system in order to investigate the plastic deformation behavior of these phases. A special focus is placed on the hexagonal μ-phase. To this aim we apply nano-mechanical testing methods: nano-indentation and micropillar-compression to enable plastic deformation of these brittle phases. This is due to the confining pressure in nano-indentation and the reduction in specimen size in micro-compression experiments. Indentation experiments at room temperature show a hardness of ~11 GPa and a Young's modulus of ~270 GPa. Electron backscatter diffraction (EBSD) assisted slip trace analysis reveals dominant dislocation activity on basal planes at room temperature. Micro-compression experiments on well-oriented single-crystalline micro-pillars reveal the structure related anisotropy of the critical shear stresses (CRSS) of different slip systems. Finally, transmission electron microscopy (TEM) and high-resolution transmission electron microscopy (HR-TEM) investigations of specimens target-prepared from nano-indents and deformed micro-pillars reveal the dislocation and defect structures of the μ-phase.