(NANO-)MECHANICAL PROPERTIES AND DEFORMATION MECHANISMS OF THE TOPOLOGICALLY CLOSED PACKED FE-MO55 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 and intrinsic deformation mechanisms are largely unknown, due to their large and complex crystal structures and pronounced brittleness. Here, we present a first detailed investigation of the mechanical properties and deformation behaviour of the Fe_7Mo_6 µ-phase acting as a model system. Utilising room temperature nanoindentation and varying load and loading rates, the average hardness and indentation modulus are measured to be 11.7 GPa and 250 GPa, respectively. EBSD-assisted slip-trace analysis and TEM reveal that deformation occurs predominantly by basal and prismatic slip, where the highest hardness results from prismatic slip and intersecting slip planes and the lowest hardness values occur where only basal slip is activated. Micropillar compression experiments are used to calculate the CRSS for the dominant glide planes. Further, more detailed investigations of plastic deformation and dislocation movement is carried out by HR-TEM, showing clear evidence of mechanically induced synchro-shear on basal planes of stacked C14-Laves-subcells.

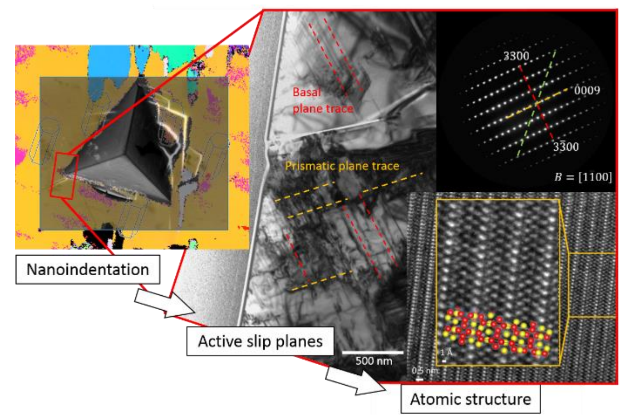

Figure 1 - Deformation analysis from nanoindentation down to atomic scale imaging of dislocation movement