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Topic: Interfaces in deformed high entropy alloys

Our work focuses on understanding the kinetics and thermodynamics of microstructure evolution in mechanically deformed single-phase and dual-phase high entropy alloys (HEAs). In case of single phase HEAs, the transitions in the mechanical properties, defect structures and the stability or migration of grain boundary networks in face centered cubic (FCC) Ni-CoCrFeMnNi mixed system is of interest, going step by step from pure Ni to equiatomic CoCrFeMnNi alloy. The dual-phase HEA system forms by severe plastic deformation induced intermixing of single-phase FCC CoCrFeMnNi and BCC HfNbTaTiZr alloys forcing both sides to co-deform. We investigate how dislocations interact with phase boundaries, which represent a break in the symmetry of the crystal lattice, as well as the effect of heterophase interfaces in phase decomposition and element migration.

The goal of this study is to unravel the influence of lattice structure and microstructure evolution on the thermomechanical properties and phase stability in our single-phase and dual-phase HEA systems using multilateral approaches involving experiment, theory and simulations. The processing of FCC alloys will involve severe plastic deformation using high pressure torsion with subsequent thermal analysis via differential scanning calorimetry (DSC) and in-depth scanning electron microscopy (SEM) and transmission electron microscopy (TEM). Microstructural investigation on all relevant length scales, from the atomic high resolution-TEM to micro-scale electron backscatter diffraction (EBSD) analysis, as well as ex situ to in situ TEM shall reveal defect structures, lattice strain and the characteristics of internal homo- grain boundaries (GBs) and hetero-phase interfaces such as segregations, dislocation pile-ups and strain fields.

Further analyses of the mechanical performance in these single phase and dual phase materials involves micro- and nano- indentation which in correlation with the microscopy results investigate the contribution of grain boundaries to work hardening and phase instabilities at different temperatures, where they’re expected to act as nucleation centers for structural transformation such as phase decomposition or structural phase formation.