MM 16: Mechanical Properties

Time: Tuesday 14:00–15:00 Location: H44

MM 16.1 Tue 14:00 H44

co-electrodeposition of compositionally complex co-cr-fe-mo-ni alloy thin films — •hongshuai li, martin peterlechner, and gerhard wilde — Institute of Materials Physics, University of Münster, Wilhelm-Klemm-Str. 10, 48149 Münster, Germany

Co-Cr-Fe-Mo-Ni, a compositionally complex alloy with a face-centered cubic structure, was successfully obtained by electrochemical deposition. To achieve a smooth morphology, an aqueous electrolyte with several additives was used as the solution for electrodeposition. Since the characterization of the sample requires a certain thickness, the electrodeposition time was set to 10 min. Characterization of the film deposited under a constant current density reveals the deposit is metallic with a face-centered cubic structure. The adhesion properties as well as the effective mechanical performance have also been tested by nano-scratch experiments, indicating a microscopically ductile behavior. The electrolytes developed in this study may be a promising approach for the electrodeposition of Co-Cr-Fe-Mo-Ni medium entropy alloys.

MM 16.2 Tue 14:15 H44

orientation dependence of the deformation mechanisms of cocrfeni high entropy alloys — •haihong jiang, martin peterlechner, and gerhard wilde — Westfälische Wilhelms-Universität Münster, Institut für Materialphysik, Wilhelm-Klemm-Str. 10, D-48149 Münster, Germany

The mechanical behavior of CoCrFeNi high entropy alloys in different deformation states have been analyzed by nanoindentation. Microhardness and Young's modulus values were determined at high accuracy as a function of the specified crystallographic orientations, which were measured by electron backscatter diffraction (EBSD). Modulus and Poisson's ratio values of polycrystalline CoCrFeNi were calculated from experimentally determined ultrasonic velocities for comparison. This approach allows for in-depth analysis and comparison of the mechanical properties as function of the local orientations of the crystal lattice in dependence of the thermo-mechanical history.

MM 16.3 Tue 14:30 H44

Influence of crack tip radius on fracture toughness: an atomistic study — •Tarakeshwar Lakshmipathy[1] and Erik Bitzek[1,2] — [1]Department of Materials Science and Engineering, Institute I, Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), Germany — [2]Department Computational Materials Design, Max-Planck-Institut für Eisenforschung, Germany

In fracture mechanics, initial cracks are typically assumed to be infinitely sharp, leading to a singularity in the crack tip stress field. However, on the atomic scale, crack tips have a radius of at least one atomic distance, which removes the singularity and leads to high, but finite stresses directly at the crack tip. Furthermore, cracks may blunt due to various reasons which leads to an increase in the macroscopic stress to reinitiate a sharp crack. Using harmonic "snapping spring" nearest-neighbor potentials which provide the closest match to linear elastic fracture mechanics (LEFM) on a discrete lattice, we show that the LEFM model for sharp cracks is insufficient to describe the boundary value problem (BVP) of blunted cracks at the atomic scale. We also show that the LEFM-based equations for blunted cracks are insufficient to describe the stress distribution ahead of atomically blunted cracks. We develop a semi-empirical scaling relation for blunted cracks using the LEFM-based equations for elliptical cracks by introducing a factor to account for the deviations. Furthermore, we identify a lower bound for the maximum crack tip radius at which this factor stops playing a role and a scaling model from the unmodified LEFM-based equations for elliptical cracks can be used.

MM 16.4 Tue 14:45 H44

Interplay of Cottrell atmosphere formation and carbon ordering in ferrite — •Sam Waseda, Tilmann Hickel, and Jörg Neugebauer — Max-Planck-Institut für Eisenforschung, Dusseldorf, Germany

In common steels, carbon atoms are purportedly or unintentionally added and alter mechanical properties of the steels. In ferrite, it is proposed that much of them does not stay as solid solution and ends up in the following possibilities: 1, segregate to structural defects; 2, make an elastically favorable ordered structure (Zener-ordering); 3, diffuse to other phases or form a precipitate (austenite, cementite etc.). While they are individually well studied, the interplay between these different scenarios is hardly studied. In this work, we present a density-based diffusion model to study the chemical and elastic interactions between Fe and C as well as among C, in order to understand the interplay between the formation of Cottrell atmospheres and the Zener-ordering.