GRADUATE STUDENT RESEARCH SEMINAR SERIES (2020)

THE FATIGUE CHARACTERISTICS OF THE HIGH ENTROPY ALLOY CoCrFeNi, AND THE ROLE OF Mn IN THE DEFORMATION MECHANISMS OF 3D TRANSITION METAL HEAs

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CoCrFeNi is a single phase high entropy alloy (HEA) with a FCC structure. Fatigue crack growth experiments were performed at room temperature on single edge notch samples of CoCrFeNi. The experiments consisted of cyclic loading in uni-axial tension with multiple load ratios, R, and a naturally increasing stress intensity factor, ΔK. Images were taken of the samples under loading and displacement fields determined through digital image correlation. The sample images and displacement fields were used to determine crack length and the level of crack closure. The material exhibited good fatigue crack growth resistance, with a Paris-Erdogan Law exponent $m \approx 2.5$. Post-mortem fractography revealed significant surface roughness and microstructural features indicating high levels of roughness-induced crack closure for low load ratios. Fractography also showed step features and surface cracking symptomatic of quasi-cleavage fracture. TEM analysis was performed for further investigation of the step features revealing that the plastic deformation mechanism changed from dislocation slip to nano-twinning as ΔK increased over crack life. Comparisons to the Cantor alloy, CoCrFeMnNi, and the medium entropy alloy CoCrNi present insights into individual elements influence on the material properties.

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