Understanding the Deformation Behavior of Refractory High Entropy Alloys

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Project Summary: This program will provide a fundamental understanding of the deformation mechanisms in refractory high entropy alloys (RHEAs) by validating emerging computational and model predictions of chemical short range order (SRO) and its effect on deformation. The amount of SRO in RHEAs will be predicted by molecular dynamics techniques using interatomic potentials recently developed by the materials science community. These computational predictions will then be compared with experimental measurements of SRO at the nanometer-scale using direct electron detector enabled extended energy loss fine structure (EXELFS) in a transmission electron microscope. These measurements of SRO will then be correlated to the deformation behavior using high resolution digital image correlation (HRDIC) in a scanning electron microscope. In addition to shedding light on the strengths and deficiencies of current computational tools and models, the new mechanistic understanding of deformation in these nascent alloys will enable their development and optimization for operation in extreme environments of interest to the DoD.