Mechanisms of Damage Tolerance of CrCoNi-Based High-Entropy Alloys

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Equiatomic multi-component alloys are an intriguing new class of materials that have recently received significant attention in the materials science community. Some of these alloys can crystallize as single-phase solid solutions with simple crystal structures despite containing high concentrations of elements with very different crystal structures which makes them interesting from a fundamental scientific viewpoint. Additionally, they can display a good combination of mechanical properties specifically ultra-high toughness making them attractive for a wide range of applications. Here we examine single-phase medium- and high-entropy face-centered-cubic (FCC)CrCoNi-based alloys, which exhibit exceptional combinations of strength, ductility and fracture toughness at ambient to cryogenic temperatures. We further use in situ transmission electron microscopy to identify in real time a synergy of deformation mechanisms including planar dislocation slip, rapid motion of partial dislocationsmassive cross slip, near-tip crack bridging and deformation induced nano-twinning.