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Deformation twinning in polycrystalline medium- and high-entropy alloys

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The present work aims to review recent progress in understanding the parameters that affect the onset of deformation twinning in polycrystalline medium- and high-entropy alloys (MEAs/HEAs) from the Cr-Mn-Fe-Co-Ni system. In this study, the materials were thermo-mechanically processed to obtain single-phase, chemically homogeneous face-centered cubic alloys with different grain sizes. These recrystallized alloys were tensile strained at room and liquid nitrogen temperatures until failure to correlate stress-strain curves and work hardening behavior with deformation mechanisms. To identify when deformation twinning is triggered, additional tensile tests were interrupted at different strains followed by transmission electron microscopy analyses. From these findings, the critical uniaxial stress for twinning was determined for several MEAs and HEAs [1-3]. In all cases, the twinning stress was found to be independent of temperature. We also investigated the effect of grain size on deformation twinning and found that it tends to decrease with increasing grain size. When the latter is accounted for, extrapolated twinning stresses for infinite grain size (~single crystal behavior) are, as expected, found to scale with the intrinsic stacking fault energy. Comparisons will be made with experimental and theoretical studies of monocrystalline alloys where possible.

Keywords: Twinning; Grain size effect; Stacking fault energy; FCC

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