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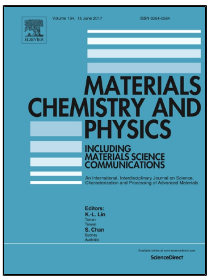

Influence of compositional inhomogeneity on mechanical behavior of an interstitial dual-phase high-entropy alloy

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Influence of compositional inhomogeneity on mechanical behavior of an interstitial dual-phase high-entropy alloy

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Abstract

In this study we present and discuss the influence of compositional inhomogeneity on the mechanical behavior of an interstitially alloyed dual-phase non-equiatomic high-entropy alloy ($Fe_{49.5}Mn_{30}Co_{10}Cr_{10}C_{0.5}$). Various processing routes including hot-rolling, homogenization, cold-rolling and recrystallization annealing were performed on the cast alloys to obtain samples in different compositional homogeneity states. Grain sizes of the alloys were also considered. Tensile testing and microstructural investigations reveal that the deformation behavior of the interstitial dual-phase high-entropy alloy samples varied significantly depending on the compositional homogeneity of the specimens probed. In the case of coarse-grains (~300 μm) obtained for cast alloys without homogenization treatment, ductility and strain-hardening of the material was significantly reduced due to its compositional inhomogeneity. This detrimental effect was attributed to preferred deformation-driven phase transformation occurring in the Fe enriched regions with lower stacking fault energy, promoting early stress-strain localization. The grain-refined alloy (~4 μm) with compositional heterogeneity which was obtained for recrystallization annealed alloys without homogenization treatment was characterized by almost total loss in work-hardening. This effect was attributed to large local shear strains due to the inhomogeneous planar slip. These insights demonstrate the essential role of compositional homogeneity through applying corresponding processing steps for the development of advanced high-entropy alloys.

Key words: High-entropy alloy; compositional homogeneity; mechanical properties; dual phase; transformation-induced plasticity.