The mechanical properties and microstructure evolution of nano structured $CoCrFeMnNiC_2$ high entropy alloy after annealing

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Abstract

Cantor type high entropy alloy Co1Cr0.25Fe1Mn1Ni1 with 2 at. % carbon interstitials addition was processed by high pressure torsion (HPT) under 6.5GPa by 3 turns at room temperature to obtain nanocrystalline grains. The microstructures and mechanical properties of samples were investigated after annealing in temperature range from 200 up to 600°C for one hour. The hardness and yield strength increased with the annealing temperature increasing and reached the maximum after annealing at 500°C. Further increase of the annealing temperature leaded to a drastic decrease of hardness and of tensile strength, moreover specimen produced at 530°C exhibited extremely brittle fracture. Transmission electron microscopy (TEM) investigations indicated that Cr segregations at the grain boundaries are the main feature of the alloy microstructure after annealing at 500°C. After annealing at 530°C and 560°C nano-sized particles of NiMn and CoFe phases and carbides precipitated massively from fcc solid solution, whereas after annealing at 600°C notable grain growth was observed and only carbides remained in the alloy. The deformation mechanisms were investigated combining the TEM microstructure characterization and fracture surface morphology.

Key words: High entropy alloy, nanocrystalline, annealing, precipitates, strength and ductility