Temperature Dependencies of Structural and Magnetic Properties of $(CoCrFeNi)_{1-X}Mn_X$ High-Entropy Alloys

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Abstract

CoCrFeNiMn high entropy alloy (HEA) is currently known to possess high strength and excellent toughness. The mechanical and magnetic properties of CoCrFeNiMn are more prominent at low temperature. In this study, we applied Bridgman method to fabricate single-crystal $(CoCrFeNi)_{1-x}Mn_x$ HEAs as a function of Mn composition. The structure and magnetic properties of polycrystalline CoCrFeNi, polycrystalline CoCrFeNiMn, and single-crystal $(CoCrFeNi)_{1-X}Mn_X$ HEAs were investigated at room temperature and low temperature. It was found that the more concentration of Mn, the higher the lattice constants and the weaker the magnetic properties are. Nano X-ray Laue diffraction mapping was exploited to examine the effects of Mn on the local structure and chemical distributions. The Ni-Mn rich region was observed in all $(CoCrFeNi)_{1-X}Mn_X$ single crystals, revealing the chemical heterogeneity induced by Ni-Mn and Co-Cr-Fe segregation. Among the constituent elements, the difference between Mn and defects has a stronger relation to the macroscopic magnetic properties of $(CoCrFeNi)_{1-X}Mn_X$ single crystals.

Keywords: high entropy alloy, magnetic property, *in-situ* neutron diffraction, crystal structure