

Synchronous improvement in mechanical property and corrosion resistance of FeCrNiCoMn high entropy alloy using boron doping

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Abstract The outstanding high-strength of high-entropy alloys (HEAs) depends on a synergistic effect of various strengthening methods, such as precipitation strengthening. However, the precipitates hamper the corrosion resistance by common understanding, leading to a reduced ability of these precipitation-strengthened HEAs to withstand complex environments. In this work, we proposed a boron-doping strategy to balance the conflict between mechanical properties and corrosion resistance in an equiatomic FeCrNiCoMn HEA. As expected, the yield strength (YS) and ultimate tensile strength (UTS) were gradually enhanced with increased boron-doping content, due to the strengthening effect of boride precipitates and grain refinement. Different from the regular experience in the effect of precipitates, 1 at.% boron doping improved the corrosion resistance of FeCrNiCoMn HEA in 3.5 wt.% NaCl solution, which was attributed to the competition between grain refinement and boride precipitation. The proper boron doping led to pronounced grain refinement, which promoted the rapid formation of a less defective and more stable passive film, thus prevailing over the detrimental effect of boride precipitates by inducing Cr-depleted zones. Therefore, both the strength and corrosion resistance of the FeCrNiCoMn HEA were simultaneously improved by doping 1 at.% boron. The present results demonstrate an effective strategy to regulate the balanced properties of precipitation strengthened HEAs and provide inspiration for future research aimed at developing these materials for diverse applications.

Keywords: High-entropy alloys, boron doping, corrosion resistance, mechanical property