Achieving superior strength-ductility synergy and enhanced corrosion resistance in a novel medium-entropy alloy via grain refinement strategy

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Abstract The effect of grain size on mechanical properties and corrosion resistance of $Ni_{62}Cr_{10}V_{28}$ MEA was investigated. The findings indicated that grain refinement significantly enhanced the corrosion resistance of the investigated alloys, attributed to the distinctive characteristics of grain boundaries and the fast formation rate of passive film. Although samples with smaller grain sizes contained a higher density of the GBs, thereby potentially increasing corrosion sensitivity, it was noteworthy that such finer grains also implied a greater abundance of low-angle grain boundaries (LAGBs) and special boundaries, significantly enhancing resistance to intergranular corrosion. Moreover, the elevated fraction of GBs facilitates the rapid transport of Cr elements to the substrate surface, thereby enhancing the formation of a dense and compact Cr-containing oxide film. This also contributes to the development of a thicker passive film layer. Additionally, the investigated alloys demonstrated a yield strength ranging from 518.7 MPa to 714.2 MPa, accompanied by an elongation ranging from 46.29% to 50.48%, thereby attaining a superior strength-ductility balance. The relationship between yield strength and grain size follows the Hall-Petch equation, and the fitted K_y value of $Ni_{62}Cr_{10}V_{28}$ MEAs is 1388 MPa·μm-1/2, significantly higher than those of other alloys reported in previous literature.Overall, grain refinement demonstrates a favorable synergistic effect on both mechanical properties and corrosion resistance.

Keywords Medium entropy alloy; Corrosion resistance; Mechanical property

Reference

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