

Evaluation on the microstructure and corrosion properties of in situ prepared HEA-boride cermet composite

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Abstract: The interactions and synergies between the different components of high entropy alloy (HEA) can endow the material with special features. Therefore, HEA-boride cermet composite is prepared via an in-situ reaction for the first time. The microstructure evolution and corrosion resistance are investigated for sintering temperatures in the range of 1000–1300 °C.

The phase structure contained Mo₂FeB₂, MoB₂, and FCC. The hard phase of the composite was composed of Mo₂FeB₂, MoB₂, whereas the bond phase comprised various types of alloys or intermetallic solid solutions. The highest percentage of the Mo₂FeB₂ phase was 48.9% at 1100 °C. The Mo₂FeB₂ phase exhibited a preferential growth tendency along the {100} crystalline plane. As the sintering temperature increased, the preferential growth of Mo₂FeB₂ in the {100} crystalline plane gradually increased.

The composite sintered at 1100 °C exhibited the most favorable corrosion resistance as a result of the synergistic effect of the Mo₂FeB₂ corrosion-resistant phase, small grain size, low porosity, and low strain dislocation level. The OCP was -0.34 V, E_{corr} was -0.52 V, and I_{corr} was 2.07×10⁻⁶ A/cm². As a crystal with a tetragonal structure, the densely arranged surface of Mo₂FeB₂ was a {111} crystal plane. Consequently, the {110} crystal plane, which was in close proximity to the {111} crystal plane, exhibited a lower surface energy and denser atomic arrangement, rendering it less susceptible to corrosion. Nevertheless, an elevated sintering temperature diminished the ability of Mo₂FeB₂ to grow along the {110} crystal plane, thereby accelerating the corrosion rate of the cermet. In addition, the high dislocation density could provide additional corrosion channels or active sites, facilitating the penetration and diffusion of corrosive media into the interior of the material. The lowest level of small-angle grain boundaries in cermet was observed at a sintering temperature of 1100 °C, resulting in a relatively low concentration of localised high energies and dislocations.

Keywords Sintering, Cermet, High entropy alloy, Microstructure, Corrosion Performance