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Microstructure and mechanical behaviors of Gd_xCoCrCuFeNi high-entropy alloys

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Abstract

A new series of Gd_xCoCrCuFeNi ($x = 0, 0.05, 0.1, 0.2, \text{ and } 0.3$) high entropy alloys were synthesized to investigate alloying effects of the rare-earth element, Gd, on the microstructure and mechanical behaviors. Microstructures of these alloys were examined using X-ray diffraction, scanning electron microscopy, and transmission electron microscopy, and the phase evolution was characterized and compared using the previous criteria. It was found that the microstructure changes from the face-centered cubic matrix plus Cu-rich face-centered cubic phase to face-centered cubic matrix plus hexagonal structure phase (CaCu₅ type) with the addition of Gd. The volume fraction of the hexagonal structure phase increases with increasing the Gd content, which is mainly responsible for the increment in the Vickers hardness, yield and fracture strength. Nanoindentation measurements show that the hexagonal structure phase is harder. Furthermore, the dislocation nucleation of the face-centered cubic and hexagonal structure phases was probed by measuring the first pop-in behavior in the load-displacement curve. With the increase of Gd, the series of Gd_xCoCrCuFeNi high entropy alloys show different fracture and strengthening

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