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Fabrication and characterization of WC-AlCoCrCuFeNi high-entropy alloy composites by spark plasma sintering

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Abstract : Mechanically alloyed AlCoCrCuFeNi high-entropy alloy (HEA) powders were used as binder to fabricate WC/HEA composites by spark plasma sintering. The effects of sintering temperature, duration time and binder content on microstructures and mechanical properties were studied. Compared with cobalt binder, the HEA binder has an advantage on the inhibition of WC grain growth due to the sluggish diffusion effect, and the average WC grain size decreases with increasing HEA binder content. Furthermore, the fracture toughness of WC/HEA composites firstly increases with increasing Vickers hardness and then decreases. A good comprehensive mechanical property was obtained after sintering at 1250 °C for 5 min with 10 wt.% HEA binder under a sintering pressure of 30 MPa. The Vickers hardness is 1922 HV₃₀ and the fracture toughness is 10.41 MPa m^{1/2}, which are higher than those of commercial WC/Co composites. Therefore, the AlCoCrCuFeNi high-entropy alloy has a potential to be a binder for WC.

Keywords: tungsten carbide; high-entropy alloy binder; spark plasma sintering; microstructures; mechanical properties

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