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Novel Ti/Al-Cr-Fe Metal Matrix Composites Prepared by Spark Plasma Sintering with Excellent Wear Properties

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Abstract : In this study, microstructure and sintering mechanism as well as wear resistance properties of Ti/Al-Cr-Fe metal matrix composites (MMCs) fabricated by spark plasma sintering (SPS) with Ti as matrix and Al-Cr-Fe as reinforcement were investigated. Phases and microstructure of the sintered samples were analyzed using X-ray diffractometry (XRD), scanning electron microscopy (SEM), energy dispersive spectroscopy (EDS) and transmission electron microscopy (TEM). Wear resistance properties were tested by ball-on-disk method. An Al3Ti ring forms around each Al-Cr-Fe particle as the bonding layer between Ti and Al-Cr-Fe particles. The Al content in Al-Cr-Fe particles experiences a decrease from 70 at.% to 60 at.% in the sintering process. And these particles consist of quasicrystalline icosahedral AlCrFe and quasicrystal approximants ɣ-brass Al8(Cr,Fe)5 and Al9(Cr,Fe)4 in the sintered compact. The addition of Al-Cr-Fe particles into the Ti matrix can improve the microhardness by about 40% and the wear resistance is improved by more than 50% due to the increase in the microhardness and the change of wear mechanism.

Keywords : metal matrix composites, spark plasma sintering, phase transformation, wear
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