FABRICATION AND CHARACTERIZATION OF METAL-HIGH ENTROPY ALLOY COMPOSITES

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Abstract

The scope of the present study is focused on high-entropy alloy (HEA), a new type of alloy system-reinforced aluminium metal matrix composite (AMMC) development. The novel metal–metal composite is fabricated through powder metallurgy by reinforcing prepared AlCoCrCuFe HEA particles with aluminium. Headed for identifying the effect of HEA on aluminium, weight percentage of HEA is varied from 0 to 15% with an equal interval of 3%. By using X-ray diffractometer, phase constituents of HEA and Al base material are analysed besides the fact that the scanning electron microscope is utilized for morphology analysis of HEA particles and AMMC. Density of the aluminium increases gradually with the increase in HEA content due to higher density of reinforcements, and maximum microhardness of 71.3 HV is attained for 15% HEA reinforcement addition which is 37.6 HV for unreinforced aluminium. Among the various predictive methodologies, the density and hardness of Al–AlCoCrCuFe metal–metal composite are found close to the values predicted by the Reuss and Voigt model, respectively. Decrease in wear rate was found for aluminium MMC with the increase in HEA reinforcement addition.

Keywords: *High-entropy alloy, metal–metal composite, powder metallurgy, hardness, wear*

Introduction

There has been increasing development of aluminium-based metal matrix composites in recent years with the aim of reducing weight of components in structural applications and also for mechanical and physical property enhancement.[1] Aluminium metal matrix composites (AMMC) with particulate reinforcements are now emerging as an important class of high-performance materials and are better known for light weight, high electrical conducting ability and resistance to corrosion.[2] Usually ceramics (normally carbides, oxides, nitrides and borides) are used as reinforcing agents in particulate metal matrix composite's (MMC) owing to their high strength, stiffness and high brittle nature. Among the number of ceramic reinforcement, refractory carbides such as SiC, Al_2O_3, B_4C and TiC are mostly utilized for fabricating particulate AMMCs.[3] Though there are many advantages with MMCs, poor plasticity, poor wettability, low hardness and stiffness in high temperature and the compatibility between matrix and reinforcement are the main problems that are still encountered in MMC fabrication. To overcome these setbacks, ceramic-reinforced MMCs can be replaced by metal–metal composites.[1] Metallic glasses and HEA are the two potential materials for use as reinforcements in metal–metal composites. However, applicability of metallic glasses as reinforcements is hindered by its low crystallization temperature and easy cracking due to poor plasticity of metallic glasses.[4] So, HEA having similar thermal expansion coefficient with temperature as that of metals that devoid of transformation in phase[5] can be used as reinforcing elements in fabricating metal–metal composite.

HEAs with their naturally less reactive character and sluggish diffusion behaviour over and above high strength

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