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Research Paper

Microstructure characterization and thermal properties of Al-TiC sintered nano composites

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HIGHLIGHTS

- Prepared Al-TiC nano composites by powder metallurgy.
- All the relative density of the composites has been prepared to ⩾90%.
- Addition of TiC, the hardness of composites increased.
- Particle size reduction affects the change of enthalpy during decomposition.
- High TiC content decreases the electrical conductivity.

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ABSTRACT

Aluminium matrix infused with titanium carbide (TiC) particles was prepared by means of powder metallurgy process. The effect of TiC addition on microstructure, thermal properties, hardness and electrical conductivity of as-sintered Al-TiC with 2 µm and ⩽200 nm reinforcement were investigated. Microstructure studies reveal the even distribution of TiC particles in the aluminium matrix. Thermal analysis of TiC with varying particle size resulted in the formation of exothermic peak, due to the reduction in the oxidation of aluminium composites. Hardness and electrical conductivity of composites have been varied based on particle size variation of TiC.

1. Introduction

Metal matrix composites (MMCs) are the focus of intense research and development worldwide for many industrial branches, where reduction in weight of elements along with the improvement in specific modulus, strength, thermal stability, wear resistance, and service life are required [1–3]. Nanoparticles-reinforced aluminium matrix composites (AMCs) are a new class of nanostructured materials, consisting of ceramic nanoparticles used as reinforcements. Various kinds of ceramic nanoparticles, e.g., TiC, SiC, B_4C, Al_2O_3 and MgO have been added to the AMCs to improve the microstructure and mechanical properties. Amongst these nanoparticles, TiC appears to be very popular, because it has a high specific strength, high modulus, low density, good wear resistance, relatively high temperature stability and good wettability with molten aluminium [4]. The aluminium alloy based metal matrix composites are generally preferred for their low density, wide alloying range, capability and response to heat treatment when used for monolithic counterparts and their intrinsic flexibility and responsiveness to processing [5–7].

In the case of Ti matrix composites, a controlled three-dimensional microstructure has the capability to enhance the properties of material, such as elastic modulus, tensile strength and fracture toughness, compared with well-distributed counterparts [8,9]. Titanium carbide-based composites with nickel alloys and iron alloys are currently used in high performance applications where wear and corrosion are the main sources of material failure [10]. For example, additions of titanium carbide (TiC), one of the hardest refractory metal carbides, with a Vickers hardness of 19.6–31.4 GPa [11], can be expected to improve the abrasion

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