Aluminium matrix composites reinforced with ceramic nanoparticles for additive manufacturing

James J. Rosero
Paula G. Saiz, Daniel Salazar, Rafael Morales

BCMaterials, Basque Center for Materials, Applications and Nanostructures, UPV/EHU Science Park 48940 Leioa, Bilbao, Spain

james.rosero@bcmaterials.net

Abstract

Aluminium alloys have been widely employed in different fields such as defense, aerospace or automotive technologies as a result of its high corrosion resistance, low density, high strength and specially because of their low cost. Nevertheless, some disadvantages such as poor wear resistance are also found in classic aluminium alloys, which limit their range of application. In this context, Aluminium Matrix Composites (AMCs) are gaining attention as their improved physical and mechanical properties allow for excellent stiffness and ductility as well as enhanced wear resistance.

In this work, AMCs have been prepared using TiC and TiB2 ceramic nanoparticles as additives (50 nm) and Al particles (45 µm) as the metallic matrix. Powders were mixed by ball milling using different weight ratios (from 0.5 to 8 %wt.) and subsequently prepared in the form of pellets by cold isostatic pressing. Finally, samples underwent a thermal treatment for deoxygenation and subsequent sintering. Obtained samples before and after thermal treatments were characterized by different techniques. X-ray diffraction and SEM-EDX were employed to analyse the crystalline structure and the morphology and distribution of the resulting AMCs. Mechanical properties of these materials were also investigated by DMA. Samples show a well distribution of the filler along the matrix as well as the formation of secondary intermetallic phases above certain temperatures. Further analysis of their potential for additive manufacturing applications is being performed.

References

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Figures

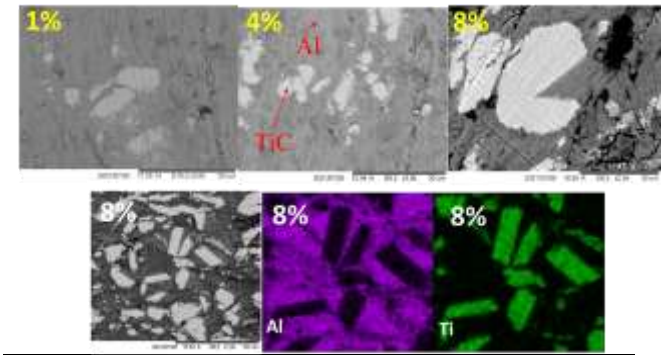

Figure 1: $TiAl_3$ intermetallic phases for AMCs reinforced with TiC nanoparticles.