Al-$ZrAl_3$ NANOSTRUCTURED COMPOSITES OBTAINED BY COLLOIDAL PROCESSING OF ALUMINIUM POWDERS

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Aluminium is very interesting from a technological point of view because its density is 2.7 g/cm3, one of the lowest values amongst metals. The main drawback of pure aluminium is its poor mechanical resistance. In order to improve it, two different ways have been explored: 1: alloying it with magnesium, zinc, copper, manganese, silicon and 2: using metallic matrix composites: the composites have both fibres and other particles that strengthen the continuous phase of the metallic matrix. In this sense, metallic matrix composites reinforced with particles such as silicon carbide, alumina, intermetallics (mainly Nickel and Copper) and other materials, have been widely reported. In these materials the reinforcement particles tend to impede the movement of the dislocations around them, restricting the plastic deformation of the material and hence leading to increments in the elastic limits, resistance to traction and increased hardness. Our research has been focused on metallic matrix composites reinforced with the intermetallic $ZrAl_3$ [1,2]

This work deals with the surface modification of aluminium powders with a zirconium alcoxide by using a colloidal route [3]. The modified powder was used to obtain dense Al/$ZrAl_3$ nanocomposites following a powder metallurgy route (Fig 1). The aluminium powder and the zirconium alcoxide were mixed in ethanol. Different slurries with zirconium percentages of 0.5, 1, and 1.5 were prepared. The slurries were then homogenized and dried at 60ºC.

Two routes were used to press the samples: 1: cold isostatic press at 200 MPa., followed by sintering in an argon atmosphere for one hour at 608, 648 and 658ºC, and 2: the samples were first heated under vacuum up to 575ºC and pressed at this temperature. The vacuum was then replaced by argon atmosphere and kept at this temperature for 1h.

The microstructure of these systems was studied by SEM and the physico-chemical properties and mechanical properties were also evaluated and discussed in terms of Zr content, sintering temperature and the microstructural features.

The results clearly show a clear improvement on the mechanical behaviour of the nanocomposites compared to Al materials. It was found that the nanoparticles have a clear pining effect on the dislocation movement and they also act as a grain growth inhibitor during sintering.

References:

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[3] M. Schehl, L. A. Díaz and R. Torrecillas, Acta Materialia, **50**, 1125 (2002).

Figures:

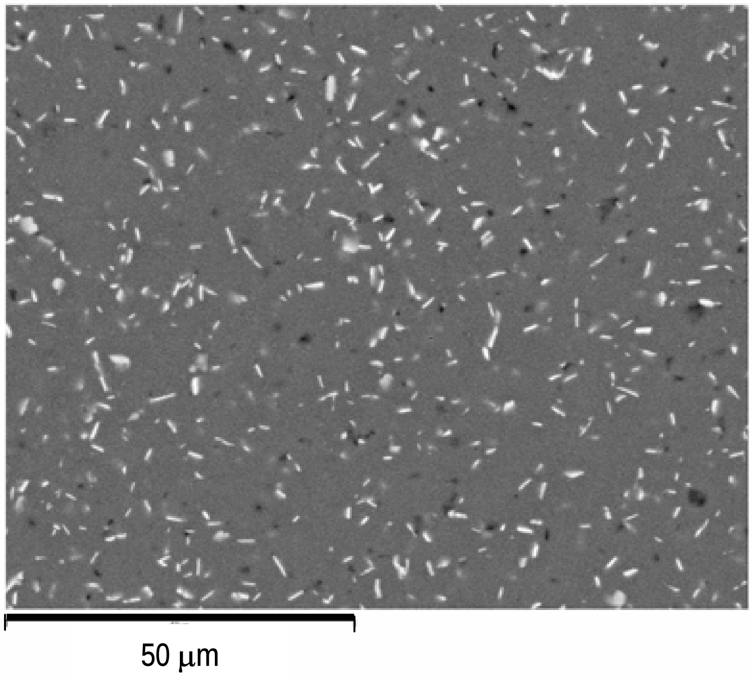

Figura 1. SEM image of an intermetallic Al/$ZrAl_3$ nanocomposite.