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Fracture Behavior of Mg-Alloy/Alumina Metal Matrix Composites

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ABSTRACT

The metal matrix composites (MMCs) made up of Mg alloy and alumina finds critical applications in the industries of aerospace, automotive and even commercially related products as components of the aircraft engine. Reinforced materials from pure magnesium and magnesium-based alloys, which can offer improvements in properties, such as stiffness, hardness, strength, fracture behavior, including wear resistance, similar to those observed in reinforced matrices of aluminum, copper and titanium. Reinforcing magnesium alloys either with ceramic particulates or ceramic fibers is likely to result in an improvement in certain mechanical properties, while also enhancing the thermal stability of materials with concomitant alteration of their responses to the chemical environment.

This paper is aimed at understanding the role of short-fiber reinforcements discontinuously dispersed through the metal-matrix of magnesium alloy on tensile deformation and fracture behavior.

Magnesium alloy (Mg-10Al- 0.13Mn) was reinforced with (Al2O3) short-fibers. Three different volume fractions of the reinforcement phase (15, 20 and 25 vol. %) were chosen and the influence of volume fraction of alumina and tensile load were studied. The mechanism of fracture that appeared in the specimens was established from the SEM micrographs of the replicas taken from different zones of the fracture surfaces. The results obtained from the finite element analysis were compared with the experimental results. It was observed that the stress intensity factor and crack growth increased with

increasing applied tensile load and volume fraction of alumina in the metal matrix composites.

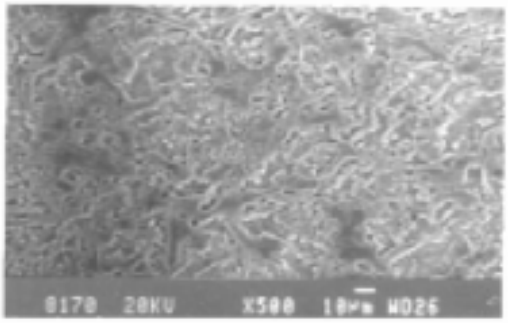

Figure 1: SEM of the Mg alloy (20vol% Al_2O_3) composite produced by the squeeze infiltration technique.

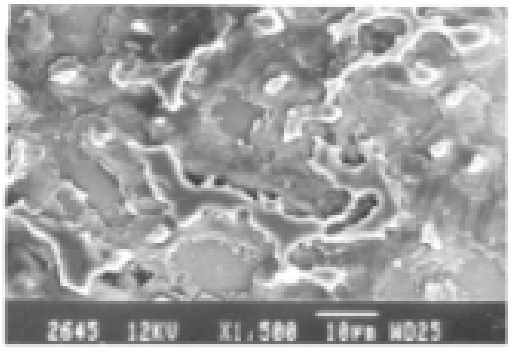

Figure 2: SEM of Mg alloy showing the region of matrix, eutectic and presence of Mg17Al12 precipitates along the grain boundary.

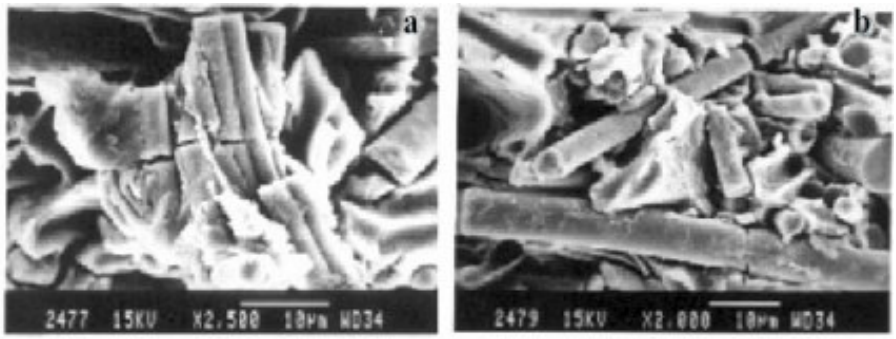

Figure 3: SEM of the Mg-alloy (25 vol% Al_2O_3) in the notched condition, showing: (a) fiber rupture or breakage, (b) slicing and de-cohesion of the fibers.

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