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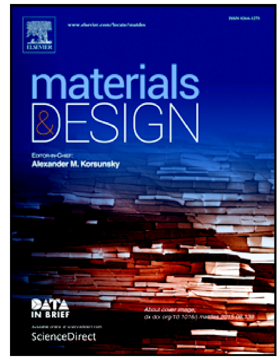

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Processing, Structure and Thermal Conductivity Correlation in Carbon Fibre Reinforced Aluminium Metal Matrix Composites

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Abstract
Al matrix composites reinforced with Cu-coated pitch-based carbon fibres (Al/Cu-CFs) were fabricated, using a novel combination of rheocasting and equal channel angular extrusion (ECAE) techniques, in order to exploit the thermal conductivity (K) of the material. Rheocasting allowed the introduction and dispersion of Cu-CFs within the Al3Mg matrix. The subsequent ECAE processing reduced the porosity of the composites from 3 to 0.03 % and induced a high degree of fibre alignment within the matrix, although considerable damage to the fibres occurred during this processing step. After 6 ECAE passes, in which the billet orientation remained constant, the composite with the highest degree of fibre alignment show a thermal conductivity (K) improvement of ~ 20 % with respect to the rheocast composite. The improvement is due to porosity reduction, improved fibre alignment and forced intimate contact of clean CF surfaces with the matrix.

Keywords: Rheocasting; Equal Channel Angular Extrusion; Metal Matrix Composites; Aluminium; Carbon Fibres; Thermal Properties.

1. Introduction

In past years the rapid development of the electronic industry has greatly benefited society. Nevertheless, more recently, some high-end technological applications have seen their advances limited by the inherent inability to find new materials capable of meeting industrial and consumer demands. One of the most challenging technological barriers that have hindered progress in electronics is the failure to remove excessive heat produced during the operation of equipment used in microelectronics and optoelectronics applications, such as microprocessors, power modules, light-emitting diodes (LEDs), plasma and liquid crystals displays (LCD) and thermoelectric coolers (TECs), to name but a few [1-3]. The amount of heat generated in electronic devices has been steadily increasing during the last few decades due to the miniaturization of components and the consumption of increasing electrical power in electronic circuits. This heat, if not efficiently removed, can cause catastrophic failures by overheating or deformation. Therefore, finding materials capable of achieving these functions, in extreme conditions (fast heating/cooling cycles, high humidity, etc.), is one of today's major challenges for this industry [1].

Traditional materials have serious deficiencies in meeting the requirements for thermal management, especially in terms of minimization of thermal stresses in electronics