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PII: S1658-3655(16)30058-9
DOI: http://dx.doi.org/doi:10.1016/j.jtusci.2016.08.005
Reference: JTUSCI 325

To appear in:

Received date: 27-6-2016
Revised date: 25-8-2016
Accepted date: 29-8-2016

Development and Characterisation of iron millscale particles reinforced ceramic matrix composite

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Abstract

The quest for quality brake pads used by aircrafts and automobiles to ensure effectiveness and safety continues to attract attention. Hence, this study was carried out as part of global efforts at tackling the problem of low durability of these friction materials. Iron millscale (IMS) particles reinforced ceramic matrix composite (CMC) was developed by powder metallurgy method and characterised. The IMS particles addition varied from 5 – 30 wt. % in each CMC produced at different particles size distribution (106- 250 µm) using silica (SiO_2), magnesia (MgO), and sodium bentonite as matrices. On the basis of close correlation between structure and property, the CMCs were subjected to physical, mechanical, and microstructural characterisation using X-ray Fluorescence (XRF), X-ray Diffraction (XRD,) and Scanning Electron Microscopy with Energy Dispersive Spectroscopy (SEM/EDS). The composite exhibits desirable physical and mechanical properties in terms of density (2.97 g/cm^3), porosity (1.24 %), linear shrinkage (1.39 %), impact energy (43.07 J), and compressive strength (114.17 MN/m^2). These values compare very well with the values of brake pads obtained in previous works and conventional/commercial brake pads indicating a potential for effective performance in service.

Keywords: Iron millscale; Ceramic composite; Characterisation; Brake pads

1. Introduction

In an attempt to effect significant improvement in the functional characteristics of brake pads of aircrafts and automobiles, different materials have been used and this has resulted into the development of different types of brake pads [1-4]. However, these brake pads are still known to be plagued by performance related issues such as wear, thermal instability, warpage and low durability [5]. The quest for quality brake pads cannot be divorced from the development of appropriate advanced materials with superlative characteristics [6]. This explains the reason why friction materials that are used in brake pad components are usually heterogeneous. They are meant to demonstrate improved wear resistance at low and high temperatures, rigidity, durability, and make less noise. Thus, during production, formulations are made by varying the weight percentages of the constituent materials in a manner that gives rise to an effective modification in the structure, physical and mechanical properties of the brake pad component [1].

The physical characterisation of a material is one of the scientific techniques