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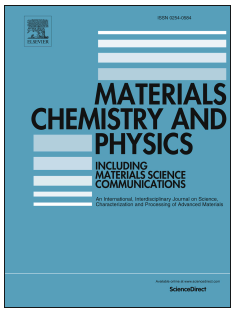

High temperature oxide-fibre/metal-matrix composites

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HIGH TEMPERATURE OXIDE-FIBRE/METAL-MATRIX COMPOSITES

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Abstract

Three families of metal matrix fibrous composites are considered in the paper as potential candidates for future heat resistant materials. Strength, fracture toughness, creep resistance and oxidation resistance of the composites are described and analyzed. Composites with nickel-based matrix are characterised by quasi-plastic behaviour and acceptable oxidation resistance. However, they cannot be used at temperatures above 1200^{o}C, which is higher than that for nickel superalloys but lower than the use temperatures for really prospective thermal machines. Discovering possibilities to reduce essentially oxidation rate of molybdenum reinforced with oxide fibres of special chemical compositions makes molybdenum matrix composites being prospective heat resistant materials with high creep resistance at high temperatures and sufficiently high fracture toughness at low temperatures. A large choice of entropy alloys (HEAs) with a variety of the properties as a matrix and availability of large number of oxide fibres produced by internal crystallisation method make oxide-fibre/HEA-matrix composites highly prospective heat resistant materials.

Keywords: metal matrix composites, oxide fibres, strength, fracture toughness, oxidation resistance

1. Introduction

The development of a future generation of gas turbines calls for the development of heat resistant materials with the use temperature much higher than that of nickel-based superalloys now is use and those under the improvement. The mainstream of the development mentioned is now molybdenum alloys containing silicide particles [1]. As for high strength metal alloys, an enhancement of their strength and creep resistance yields a decrease in fracture toughens. Hence, fibrous composites, which can be characterized by an increase in both strength and fracture toughness simultaneously [2,3], look as the most prospective materials for high temperature heavily loaded structural elements. In the present papers, the microstructure and mechanical properties of three families of heat resistant fibrous composites are reviewed. The review ~~mainly based on the paper presented at the international conference on high-entropy materials (ICHEM 2016)~~ is completed with experimental results obtained recently.

The first family contains oxide-fibre/nickel-based matrix composites. These composites cannot be used at temperatures higher than about 1200^{o}C; hence, composites with matrices of higher melting points are wanted.

The second family is that of molybdenum matrix composites. This family will have a practical importance provided necessary coatings ~~are~~ have been developed since mechanical properties of the composites such as strength, damage tolerance and creep resistance are sufficiently high at room temperature and high temperatures up to at least 1300^{o}C.

The third family of high temperature metal matrix composites appeared on the technical horizon due to the invention of high entropy alloys (HEAs) by Jeh [4]. Indeed, a unique