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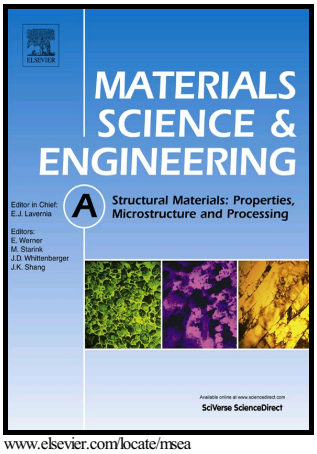

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Effect of the Annealing Process on the Microstructure and Mechanical Properties of Multilayered Zr/Ti Composites

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Abstract: To explore the potential application of Zr-based alloys as structural materials, multilayered Zr/Ti composites were fabricated by a vacuum diffusion annealing bonding process. Scanning electron microscopy (SEM) in tandem with energy dispersive spectroscopy (EDS) and electron backscatter diffraction (EBSD) was used to characterize the microstructures and chemical elemental distributions of the Zr/Ti laminated metal composites (LMCs). Micro-hardness and in-plane compression tests were conducted to evaluate the mechanical properties of the Zr/Ti LMCs. It is revealed that the microstructure of the Zr/Ti LMCs is composed of alternating Zr layers, Ti layers and Zr-Ti mutual diffusion layers (interface layers). The width of the interface layer increases with increased annealing temperature and time. The micro-hardness test results show that the hardness distribution is uneven among the different layers and that the interface layer has the highest hardness. Compression results indicate that the strength of the Zr/Ti LMCs are higher than that of the constituent materials due to the contribution of the interface layer. The diffusion coefficient and the relation between the microstructure and yield strength are also discussed in this study.

Keywords: Multilayered Zr/Ti Composite; Microstructure; Mechanical Properties; Diffusion Bonding

1. Introduction

Zirconium (Zr) based alloys are widely used as cladding materials in the nuclear industry because of their small thermal neutron absorption, excellent corrosion resistance and acceptable mechanical properties [1-3]. Zr-Sn [4, 5], Zr-Nb [6, 7] and Zr-Sn-Nb [8, 9] alloys are the most widely used Zr alloys in the nuclear power industry. In these traditional Zr alloys, the selection criteria for the alloying elements are mainly based on the effects of these elements on the thermal neutron absorption and corrosion resistance, which often pay no special attention to the mechanical properties.

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