Journal of Alloys and Compounds

Dispersion characteristics, interfacial bonding and nanostructural evolution of MWCNT in Ti6Al4V powders prepared by shift speed ball milling technique

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Abstract

The quest to achieve uniform dispersion of multiwalled carbon nanotubes (MWCNT) in metal matrices without compromising the structural integrity of the nanotubes during the production of metal matrix composites have been a lingering challenge across materials science community. The problem has compelled researchers to explore various techniques of dispersing MWCNT in metal matrices. In this study, 1.0 wt% MWCNT was dispersed in Ti6Al4V powders using shift speed ball milling technique to achieve uniform dispersion, good interfacial bonding and minimal structural strain to the MWCNT after dispersion. Two batches of dispersion techniques were adopted to disperse the nanotubes in the Ti6Al4V matrix. Batch 1 (6 h of low-speed ball milling + 1 h high-speed ball milling) and Batch 2 (8 h of low-speed ball milling + 1 h high-speed ball milling). After dispersion, various advanced characterisation techniques such as high-resolution transmission electron microscopy (HRTEM), scanning electron microscopy (SEM), Raman spectroscopy and X-Ray diffraction (XRD) were utilised to evaluate the dispersion characteristics, interfacial bonding and micro and nanostructural evolution of the MWCNT in Ti6Al4V powders. The results indicated that batch 2 sample showed the best dispersion characteristics of MWCNT, good interfacial bonding with minimal strain to the walls of the MWCNT in the Ti6Al4V powders and this is ascribed to the adequate impact energy exerted on the powders during prolong milling time of low-speed ball milling and the supplementary 1 h of high-speed ball milling.