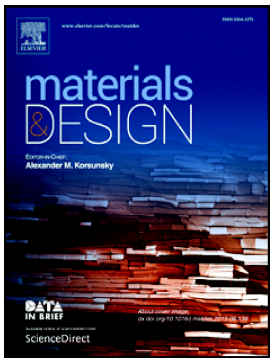

Spark plasma sintering of graphitized multi-walled carbon nanotube reinforced Ti6Al4V

A.O. Adegbenjo, P.A. Olubambi, J.H. Potgieter, M.B. Shongwe, M. Ramakokovhu

PII: S0264-1275(17)30468-9
DOI: doi: 10.1016/j.matdes.2017.05.003
Reference: JMADE 3027

To appear in: *Materials & Design*

Received date: 7 February 2017
Revised date: 29 April 2017
Accepted date: 3 May 2017

Please cite this article as: A.O. Adegbenjo, P.A. Olubambi, J.H. Potgieter, M.B. Shongwe, M. Ramakokovhu , Spark plasma sintering of graphitized multi-walled carbon nanotube reinforced Ti6Al4V, *Materials & Design* (2016), doi: 10.1016/j.matdes.2017.05.003

Spark plasma sintering of graphitized multi-walled carbon nanotube reinforced Ti6Al4V

A.O. Adegbenjo[a,*], P.A. Olubambi[a, b], J.H. Potgieter[c], M.B. Shongwe[a] and M. Ramakokovhu[a]

a. Institute for NanoEngineering Research, Department of Chemical, Metallurgical, and Materials Engineering, Tshwane University of Technology, South Africa.

b. Department of Chemical Engineering Technology, University of Johannesburg, South Africa.

c. School of Chemical and Metallurgical Engineering, University of The Witwatersrand, Johannesburg, South Africa.

* Correspondence: waleeleect@gmail.com

Abstract

Graphitized multi-walled carbon nanotubes ($MWCNT_{Gr}$) reinforced Ti6Al4V (Ti64) matrix composites prepared via the powder metallurgy route were synthesized by spark plasma sintering (SPS) technique. 1, 2 and 3 wt % $MWCNT_{Gr}$ were dispersed in the Ti64 matrices by adapted high energy ball milling ($HEBM_A$). Composite powder mixtures were sintered in vacuum at constant applied pressure, heating rate and isothermal holding time of 50 MPa, 100 °C/min and 5 min respectively. The sintering temperature was varied between 850 and 1000 °C. Scanning electron microscopy (SEM), transmission electron microscopy (TEM) and X-ray diffraction (XRD) were used to characterize the as-received MWCNTs, $MWCNT_{Gr}$, admixed composite powders and the bulk sintered composites. $MWCNT_{Gr}$ evolution during graphitization treatment, dispersion in Ti64 matrix and in the sintered composites was analyzed using the characteristic Raman peak intensity ratio (I_D/I_G). The relative density of the sintered $MWCNT_{Gr}$/Ti64 composites was enhanced with increased sintering temperature, but deteriorated with increased wt % $MWCNT_{Gr}$ in the metal matrix. Vickers microhardness of the consolidated composites improved with increasing sintering temperature and weight fractions of $MWCNT_{Gr}$ over that of the unreinforced matrix alloy. The formation of crystalline TiC interfacial product during composite powder processing and consolidation is also discussed.

Keywords: Metal matrix composites; Reinforcement; MWCNT dispersion; Interfacial reaction; Graphitization