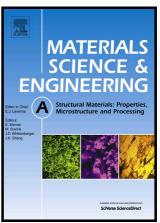
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Solvothermal-assisted graphene encapsulation of SiC nanoparticles:

A new horizon toward toughening aluminium matrix nanocomposites

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Abstract

Agglomeration of ceramic nanoparticles is a key challenge during manufacturing aluminium matrix

composites in both solid and liquid methods. This study presents an innovative fabrication route to

diminish the agglomeration of SiC nanoparticles using graphene encapsulating method stimulated by

a solvothermal process. The produced SiC nanoparticles were then incorporated into A357 molten

alloy using a liquid processing route. HRTEM investigations have shown the uniform distribution of

SiC nanoparticles wrapped by onion-liked graphene shells within the matrix of composite, conferring

273% and 400% enhancement in yield strength and tensile ductility, respectively, compared to the

unreinforced one. This is attributed to the manipulation of solidification mechanism of SiC

nanoparticles from pushing to engulfment, ensued from imparting higher thermal conductivity to these

particles by onion-liked graphene sheets. Fractographic observations have revealed the transgranular

facture mode activated due to nano-void coalescence fracture mechanism in composites reinforced

with graphene sheets associated with prolonged ductility. A devised analytical strengthening model

has also demonstrated the profound efficacy of thermal activated dislocation mechanism in fortifying

the matrix, brought about by the exceptional negative thermal expansion coefficient of graphene

sheets.

Keywords: Composites; Semi-solid processing; Mechanical characterization; Electron microscopy;

Fracture

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