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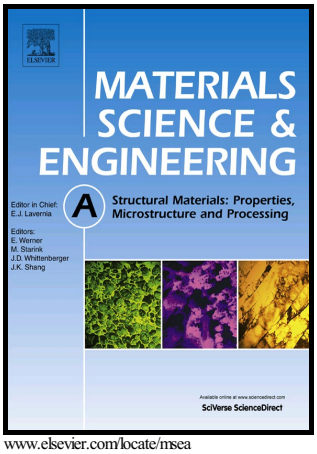

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Solvothermal-assisted graphene encapsulation of SiC nanoparticles: A new horizon toward toughening aluminium matrix nanocomposites

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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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