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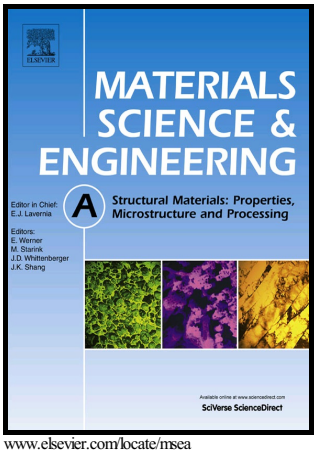

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Strengthening in Hybrid Alumina-Titanium Diboride Aluminum Matrix composites synthesized by Ultrasonic Assisted Reactive Mechanical Mixing

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Abstract

A novel ultrasonic assisted in-situ stir mixing method, in which the reinforcements are synthesized in liquid aluminum, has been used to fabricate surface clean nano- or submicron-sized particulates in pure aluminum matrix. An exothermic reaction was designed to synthesize Al_2O_3 and TiB_2 nanoparticles from TiO_2 particles and elemental boron in an aluminum melt. Subsequently, the refining power of the nanoparticles in the metallic matrix has been investigated. Experimental and theoretical analysis show that the particle size and refining power of nanoparticles is controlled by the viscosity of the melt, rather than precipitation and growth. A model is proposed to describe the effect of processing variables to the refining power of nanoparticles. Subsequently, the tensile properties were measured to determine the strengthening mechanisms responsible for the change in properties of these materials. Experimental data combined with theoretical analysis suggest that both grain boundary strengthening and Orowan strengthening seem to account for the strength in the nanocomposites.

Keywords: Aluminum; Nanocomposites; In-situ Casting; Strengthening Mechanisms; Grain Refinement

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Introduction

Metal matrix nanocomposites are reported to have improved mechanical, thermal and electrical properties as compared to their respective base alloys. To date, these materials have been synthesized mainly by powder metallurgy or deformation processing. Solidification synthesis of