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Induction Melting as a Fabrication Route for Aluminum-Carbon Nanotubes Nanocomposite

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Abstract : Increasing demands of contemporary applications for high strength and lightweight materials prompted the development of metal-matrix composites (MMCs). After the discovery of carbon nanotubes (CNTs) in 1991 (revealing an excellent set of mechanical properties) became one of the most promising strengthening materials for MMC applications. Additionally, the relatively low density of the nanotubes imparted high specific strengths, making them perfect strengthening material to reinforce MMCs. In the present study, aluminum-multiwalled carbon nanotubes (Al-MWCNTs) composite was prepared in an air induction furnace. The dispersion of the nanotubes in molten aluminum was assisted by inherent string action of induction heating at 790°C. During the fabrication process, multifunctional fluxes were used to avoid oxidation of the nanotubes and molten aluminum. Subsequently, the melt was cast in to a copper mold and cold rolled to 0.5 mm thickness. During metallographic examination using a scanning electron microscope, it was observed that the nanotubes were effectively dispersed in the matrix. The mechanical properties of the composite were significantly increased as compared to pure aluminum specimen i.e. the yield strength from 65 to 115 MPa, the tensile strength from 82 to 125 MPa and hardness from 27 to 30 HV for pure aluminum and Al-CNTs composite, respectively. To recognize the associated strengthening mechanisms in the nanocomposites, three foremost strengthening models i.e. shear lag model, Orowan looping and Hall-Petch have been critically analyzed; experimental data were found to be closely satisfying the shear lag model.

Keywords : carbon nanotubes, induction melting, strengthening mechanism, nanocomposite
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