Poster Presentation

MS098.P08

Characterization of Sn reinforced Al–Cu–Fe quasicrystalline matrix nanocomposite

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Quasicrystals are a relatively new class of materials, which belong to a family of aperiodic intermetallics, and exhibit high hardness, excellent wear resistance, low coefficient of friction, low thermal and electrical conductivity accompanied with good corrosion resistance. However, these materials are inherently brittle and show low fracture toughness [1]. It has been observed that the presence of soft phases overcomes this limitation of quasicrystals [2].
In the present investigation, Al62.5Cu25Fe12.5 quasicrystalline material was prepared by induction melting followed by heat treatment. This quasicrystalline material was reinforced with 10, 20 and 30 vol% of Sn through mechanical alloying using high energy planetary ball mill. The milling was carried out in a PM 400 Retsch ball mill at a speed of 200 rpm up to 40 h with a ball to powder ratio of 10:1 with toluene as process control reagent. The nanocomposite (NC) powders were characterised by electron microscopy and X – Ray diffraction techniques. The mechanical properties of these NC powders were evaluated by microindentation of individual NC powder particles. The hardness of NC was found to decrease with increasing volume fraction of Sn. Inverse Hall – Petch relationship was also evident for mechanically alloyed NC powder.
Further, these milled NC powders were sintered and annealed thereafter. The consolidated pellets were characterised by optical microscopy, scanning and transmission electron microscopy, x-ray diffraction. The mechanical properties of sintered samples were evaluated through micro-indentation. The hardness and fracture toughness of as-annealed Al62.5Cu25Fe12.5 quasicrystalline matrix were found to be 10.87 GPa and 1.58 ± 0.27 MPa.√m respectively. The hardness of the Sn reinforced Al62.5Cu25Fe12.5 quasicrystalline matrix composite decreased with increasing volume fraction of Sn. The fracture toughness was found to increase appreciably by 22 pct. The increase in fracture toughness was attributed to inhibition of crack propagation by Sn particles. The present study provides an insight into the mechanisms of phase and microstructural evolutions during MA of the Sn reinforced Al62.5Cu25Fe12.5 quasicrystalline nanocomposite and their consequent effects on mechanical properties. It is anticipated that the interface will be highly coherent in this class of intermetallics based composites. Attempts are made to discuss the stability of microstructure and the prospects of Sn reinforcement nanocomposite in order to improve the fracture toughness.

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Keywords: Mechanical alloying, Al-Fe-Cu quasicrystal, Sn reinforcement