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Evaluation of Heat Treatment Effect on Fracture Behavior of Aluminum Silicon Carbide Graphite Hybrid Composite

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Abstract:

Aluminum Silicon Carbide Graphite hybrid composite is a potential material for automotive and aerospace applications because of its properties like enhanced hardness, solid lubrication imparted by silicon carbide and graphite respectively. In the present research ageing heat treatment influence on fracture toughness of the hybrid composite was investigated. Aluminum 6061 silicon carbide graphite hybrid composite was fabricated through liquid metallurgy route by creating a vortex in the molten slurry and compact tension specimens for fracture toughness testing were prepared by wire EDM process. Ageing heat treatment on solutionising heat treated hybrid composite compact tension specimens for fracture toughness testing was carried out using muffle furnace at 170^0 and 270^0 C. As cast and ageing heat treated hybrid composite specimens were tested for finding the fracture toughness using Nano Universal Testing Machine.

The average fracture property of the composite ageing heat treated at 170^0C was found to be superior to as cast composite and the composite ageing heat treated at 270^0C, while the composite aged at 270^0C was found to have inferior fracture toughness compared to as cast hybrid composite. Microstructure analysis of 170^0C ageing heat treated specimens revealed precipitation of fine particles which attributes to enhanced fracture toughness. Dendritic microstructure formed in 270^0 C ageing heat treated hybrid composite resulted in lower fracture toughness.

Keywords: Aluminum Hybrid Composite, Ageing Heat Treatment, Solution Heat Treatment, Fracture Toughness.

INTRODUCTION

More than one type of reinforcement in a hybrid composite facilitates tailor-making a composite material to meet specific property requirement. Hybrid aluminum composite containing soft solid lubricant like graphite and hard reinforcement like SiC is the potential material for automotive and aerospace applications because of its enhanced hardness and tribological properties. Suresh and Shridhar conducted parametric studies on tribological behavior of aluminum SiC graphite hybrid composite and their investigation revealed that graphite reinforcement volume fraction hike up to 7.5% reduces the wear and further increase in graphite percentage leads to increase in wear tendency[1]

Achutha M V et.al., conducted three stress level fatigue tests on stir cast aluminum SiC graphite hybrid composite to arrive at stress life curves. Comparison of stress life curves of hybrid composite with the base alloy concluded that fatigue resistance of hybrid composite is superior to its base alloy [2].

Experiments carried out to investigate the volume fraction, particle size and matrix strength influence on fatigue behavior of aluminum 2124 SiC composite concludes that decrease in reinforcement particle size and increased volume fraction results in enhanced yield and tensile strength. Reinforcement of SiC enhancing the tensile strength improves fatigue resistance [3].

Investigation to evaluate the effect of cold deformation and solution heat treatment on tensile and fracture behavior of AA 6063/Al_2O_3 composites suggested that solutionising heat treatment and cold deformation results in uniform distribution of alumina particles in the matrix alloy and reduced porosity.

Increasing alumina volume percent decreases the fracture