WEAR BEHAVIOUR OF NICKEL ALUMINIDES REINFORCED ALUMINIUM METAL MATRIX COMPOSITES

A THESIS

Submitted by

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ABSTRACT

A new class of Al Metal Matrix Composites (MMCs) reinforced with in situ intermetallic reinforcements have emerged with superior wear resistance, higher tensile strength and corrosion resistance compared to Al MMCs reinforced with ceramic particulates/fibres. This enhancement is due to better interfacial bonding achieved by intermetallic reinforcements with the Al matrix. Several studies on wear behavior have been carried out on various Al alloys reinforced with nickel aluminides, titanium aluminides as well as other intermetallic reinforcements. Nickel aluminide reinforced Al MMCs have been extremely investigated (synthesized through Powder Metallurgy, Friction Stir Processing and various casting routes). In the present investigation, in-situ nickel aluminide reinforced AA6061 Al MMCs were synthesized via stir casting. Ni particles were added to Al melt in varying wt% (0.5, 1.0 and 1.5) during stir casting. Ascast composites were subjected to solutionization and peak ageing (T6) treatments to form nickel aluminide reinforcements.

Grain refinement and hardness increased with an increase in Ni wt%. peak aged (T6) composites exhibited a higher degree of grain refinement as well as hardness than solutionized and as cast composites. X-ray Diffraction (XRD) studies confirmed the formation of nickel aluminide intermetallic in the composites. Scanning Electron Microscopy/Energy Dispersive X-ray Spectroscopy studies (SEM/EDAX) revealed the distribution of nickel aluminides in the composites. Transmission Electron Microscopy (TEM) studies revealed the morphology and size of nickel aluminides formed. Wear investigations were carried out on the as cast ,solutionized and T6 composites at varying levels of laod(N), sliding speed(m/s) and Niwt% as per Taguchi's L9 array in the pin-on-disc tribometer at a constant sliding distance of 500m. Statistical analysis of wear loss and Coefficient of Friction (CoF) values indicated that Ni wt% influenced both wear and CoF of the as cast composites to

greater extent than load and sliding speed, while sliding speed had a larger influence on the wear loss and CoF of the solutionized composites. Sliding speed had a significant influence on the wear loss and CoF of the T6 composites besides the influence of load. T6 composites had showed typical adhesive wear features such as wear tracks, delamination and debris formation to a limited degree compared to as cast and as solutionized composites. Base alloy exhibited severe delamination and deep wear tracks than composite samples. As cast base alloy also exhibited highest degree of delamination.