M. Tech Thesis September 2008
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Kukatpally, Hyderabad

Clustering of Graphite Nanoparticles on Mechanical and Wear Behavior of Its Metal Matrix Composites

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ABSTRACT

Metal matrix composites represent integrated combination of metallic and ceramic phases targeted to offer enhanced properties when compared to their unreinforced matrix metal. Aluminium composites are widely employed in the aerospace and automotive industries. Ceramics such as silica, silicon carbide, silicon nitride, titanium carbide, titanium boride, titanium oxide, titanium nitride, boron nitride, boron carbide, magnesium oxide, zirconium carbide, alumina trihydrate, graphite and so on. The reinforcement may augment specific stiffness, specific strength, abrasion resistance, creep resistance, thermal conductivity, and dimensional stability. In the early nineteenth century, the graphite was used to reinforce natural rubber to increase the longevity of tires. Today, graphite is found in all aspects of domestic and industrial applications. It is used in inkjet printer ink, as reinforcements for natural and synthetic rubber, as an active agent in electrically conductive plastics, as a pigment in paints, coatings, cosmetics, etc. The graphite has high aspect ratio leading to higher surface area per unit volume. Thus, it provides more wettable surface area improving ease of dispersion.

The noteworthy feature of the present work is that the graphite (Gr) was collected from waste black ink cartridges from inkjet printing. In order to develop an empirical wear models for AA6061/Gr composites and to study the influence of agglomeration of Gr nanoparticles, the wear tests were performed on pin-on-disc equipment. The design of experiments was based on Taguchi techniques.

The investigation on the tensile and wear behavior of AA6061/Gr nanoparticles reinforced metal matrix composites was carried out experimentally and theoretically. An increase in volume fraction of Gr nanoparticles has increased the hardness of the AA6061/Gr composites and subsequently enhanced the wear resistance. The tensile strength increases with an increase of graphite content. Due to agglomeration of Gr nanoparticles, the condensed interparticle spacing is favorable to an increase in the

work hardening of AA6061/Gr composites. The worn surfaces of AA6061/Gr composites reveal subsurface fracture, cavities and bounded Gr nanoparticles in the cavities. The volume fraction of Gr and sliding distance are highly influential variables on the wear rate of composites. The wear rate decreases with the increase of volume fraction of Gr nanoparticles and decreases with the increase of sliding distance. The results derived from the predicted empirical model could match with those results acquired from the wear tests.

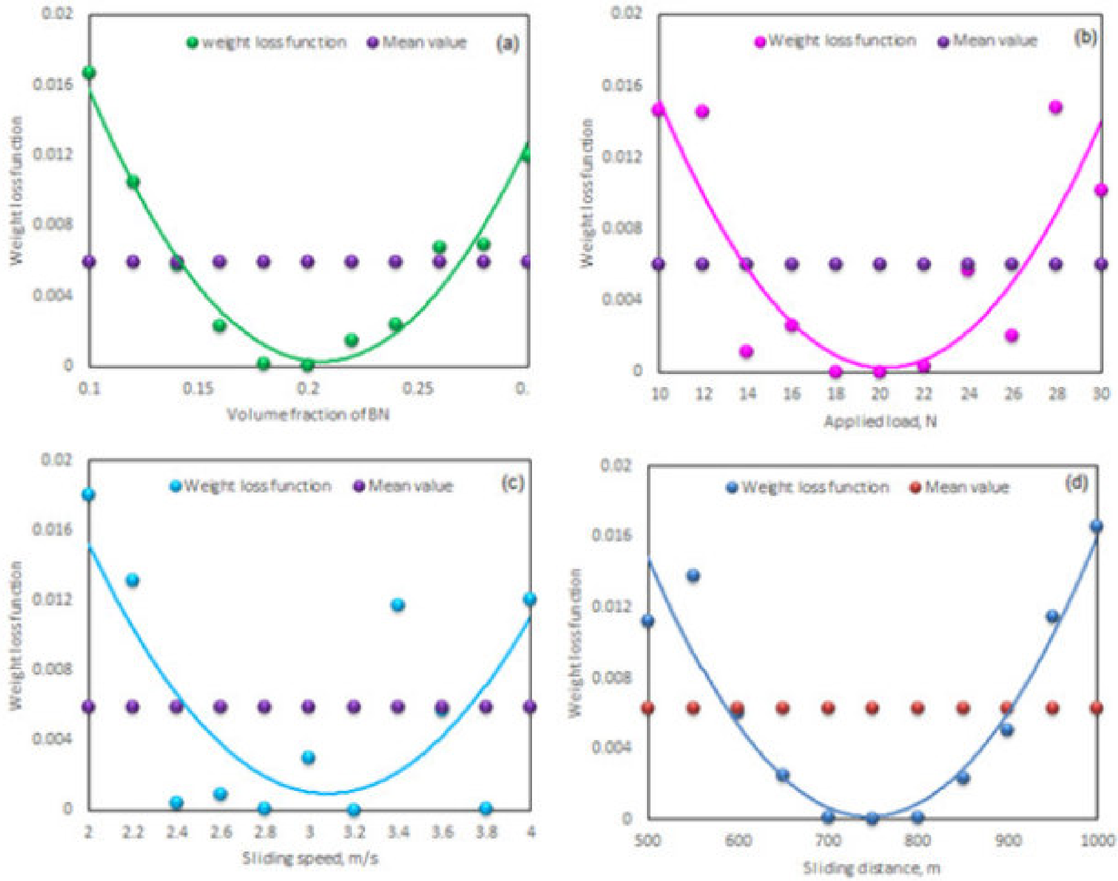

Figure 1: Weight loss functions of AA6061/Gr composites.

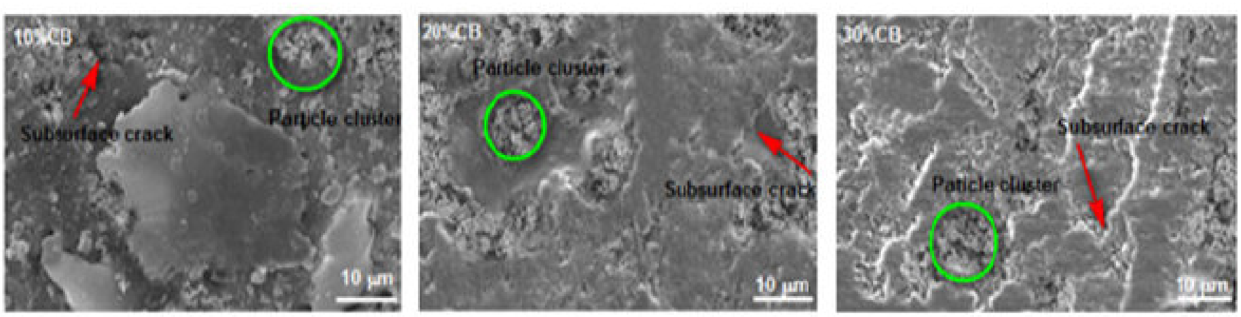

Figure 2: The worn surfaces of AA6061/Gr composites.

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