

Materials Day 2007: Sticking and Sliding, Wearing and Tearing

Tribology and Adhesion Issues in Materials Science

«Tribological Properties of Bulk Metallic Glasses and their Composites»

Marco Siegrist, Metal Physics and Technology, ETH Zürich

Metallic glasses are a new class of metallic alloys which display an amorphous atomic structure. Their lack of crystal structure generates extraordinary mechanical properties: they typically display 2-3 times the yield strength and 4 times the elastic strain limit of their crystalline counterparts, and in the form of composites they often show enhanced plastic strain. Thus, metallic glasses and their composites may be interesting for microgear applications.

In this context, we present the influence of second-phase reinforcement on the micro-tribological properties of $Zr_{52.5}Cu_{17.9}Ni_{14.6}Al_{10}Ti_5$ (Vit 105) via ball-on-disc tests. It was found that monolithic amorphous Vit 105 displays a coefficient of friction (COF) similar to that of 100Cr6 bearing steel, while a low volume content of graphite (and especially of ZrC) leads to a significant decrease in the COF, of up to 50%. Amorphous Vit 105 and its graphite-/ZrC-reinforced composites typically display two regimes of COF: after 100-500 revolutions it drops to about 2/3 of the starting value; and jumps back up to the initial COF level are also observed. These transitions take place within the space of about 10 revolutions and are accompanied by a significant change in wear track depth. Investigation of the wear rate indicates that the graphite-/ZrC-reinforced bulk metallic glass composites display an even lower wear rate than 100Cr6 bearing steel.