CARBON DOTS AS ADDITIVES IN LUBRICANT OILS

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In mechanical systems, consistent performance and energy saving demand eco-friendly and highly efficient lubricants. In today's market, 90% of lubricants are composed of hydrocarbon molecules and the rest are additives governing their behavior. In the last decade, it has increased the development of organic-inorganic hybrid lubricants by introducing nanoparticles within the base oil.

Most developments have used inorganic nanoparticles such as ZrO_2, CuO, ZnO, etc [1,2]. These nanoparticles have the disadvantage of forming non-stable suspensions in lubricant oil due to their hydrophilic surface. Often surfactants are added to enhance dispersion or, otherwise, attaching to the nanoparticle surface hydrophobic groups.

Carbon nanomaterials (carbon nanotubes, fullerene, graphene) have attracted much attention due to their unique physical and chemical properties, among which carbon nanotubes have been used as excellent additives in base lubricant oils to improve their tribological performance.

In this presentation we describe the synthesis of carbon-dots (carbon nanoparticles) from citric acid and glutathione by a hydrothermal carbonization method [2] and their surface functionalization with sodium trifluoromethane-sulfonimide (Figure 1). These nanoparticles were characterized in TEM FTIR and solid RMN.

The effect of concentration and morphology of nanoparticles suspended in lubricating oils was examined. Different dispersions were prepared by mixing the raw and the functional carbon dots with mineral oils. The lubrication performance of the dispersions was evaluated using ball-on-plate and three-point contact (ASTM 4172-94 standard test) configurations under various normal forces.

Preliminary tribological results indicated reduced wear compared with the base oil only, while friction coefficient was similar to that of the base oil (Figure 2).
These results reveal that carbon dots may act as suitable materials which could improve lubricant behavior of conventional oils. More work is in progress in order to optimize functionalization of carbon dots, size and concentration, key parameters affecting wear and friction reduction.

References

[1] A. Hernández Battez et al, Wear, CuO, ZrO2 and ZnO nanoparticles as antiwear additive in oil lubricants (2008) 422-428
[2] T. Díaz-Faes López et al, Sci. Technol. Adv.Mater., "Engineered silica nanoparticles as additives in lubricant oils (2015), **16**, 055005

Figures

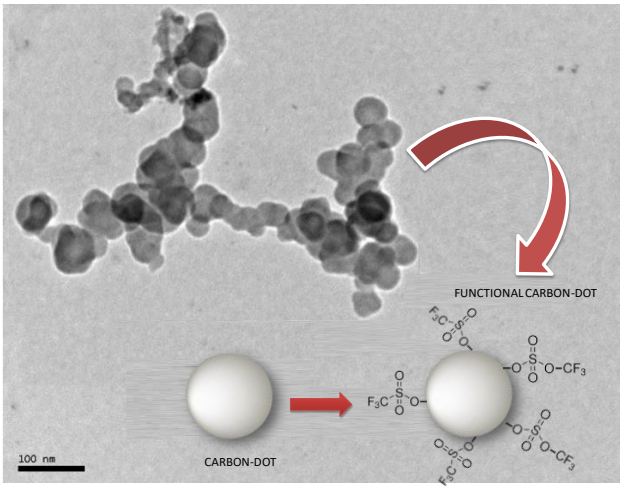

Figure 1. TEM image of functional carbon-dots.

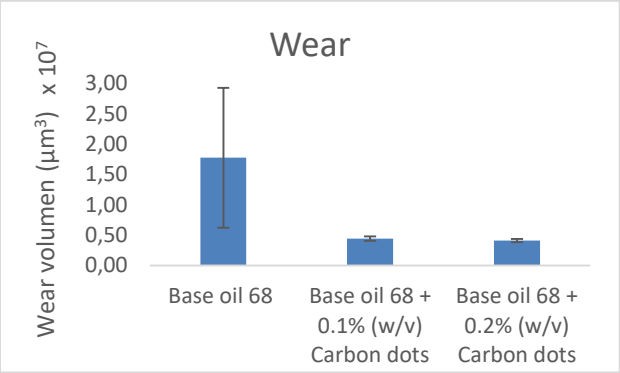

Figure 2. Wear after ASTM 4172-94 standard test of base oil and raw carbon dots.