SELF-LUBRICATING FABRIC COMPOSITES ENHANCED BY THE MICROCAPSULES TO IMPROVE THE TRIBOLOGICAL PROPERTIES

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Friction; Wear; Mixed Lubrication; Microcapsule

ABSTRACT

With the rapid development of advanced technology, the demand for wear-resistant and friction-reducing materials is increasing. Microencapsulation was a technology in which an organic or inorganic material was used as the shell layer and a solid, liquid or gas was stored inside it as the core material. In the field of lubrication, the core material in microcapsules was often chosen to be a liquid phase, which provided boundary lubrication and thus significantly reduced the coefficient of friction. However, the incorporation of microcapsules into the composites severely degraded their mechanical properties in many cases [1]. Addressing the degradation of mechanical properties due to the introduction of microcapsules and improving tribological properties was an urgent issue. Gong et al. found that reducing the particle size (65 nm) can effectively improve the mechanical properties of the composites[1]. Wang et al. prepared nanoscale microcapsules using polydopamine to encapsulate eclogite containing gold nanoparticles and ionic liquids. The mechanical properties of the composites were significantly improved[2]. In this paper, we propose two ideas to solve this problem. One way is to make the microcapsule and resin form hydrogen and chemical bonds double cross-linked. The GO-COOH/TiO_2 @PAO double-wall microcapsules (Capsule) were prepared by interfacial condensation polymerization of titanium butoxide (TBT) and self-assembly between GO-COOH and TiO_2 shell (Fig. 1). A double crosslink of chemical bond (amide or ester) and hydrogen bond were constructed between microcapsules and polyimide (PI) to improve the mechanical properties of PEEK fabric-reinforced polyimide resin (PEEK/PI). Another approach is to introduce gold nanoparticles and copper nanoparticles on the surface of TiO_2-coated jojoba oil microcapsules by photodeposition. Moreover, the hydroxyl groups on the surface of microcapsules were designed to react with the carboxyl groups of PI, which also effectively improved the mechanical and tribological properties of the composites. The strategy proposed in this work is expected to be a general solution that can be extended to other fabric composites with excellent lubricating performances by adding microcapsules with different kinds of the solid–liquid core system into the composites.

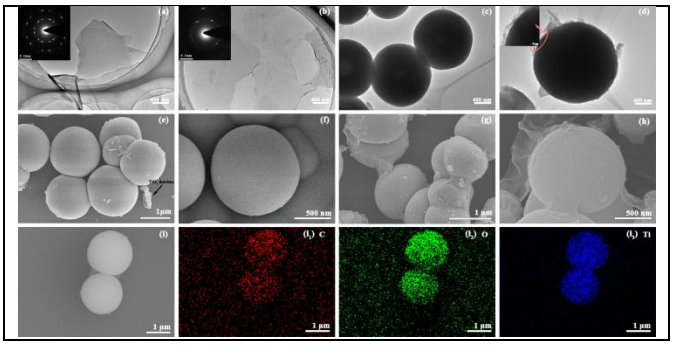

Fig.1 TEM images of (a) GO, and the inset showed the SAED pattern of GO; (b) GO-COOH, and the inset shows the SAED pattern of GO-COOH; (c) TiO_2@PAO, (d) Capsule. SEM images of (e and f) TiO_2@PAO, (g and h) Capsule. EDS image (i) and elemental mapping images (i_1-i_3) of TiO_2@PAO.

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