Oil-soluble hairy nanoparticles as lubricant additives

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Abstract:

Lubricants play a critical role in improving the durability and energy efficiency of numerous mechanical systems, including automotive engines. We have developed oil-soluble polymer brush-grafted inorganic nanoparticles (hairy NPs) as effective lubricant additives for reducing friction and wear. Well-defined oil-soluble hairy NPs with various brush molecular weights were prepared by surface-initiated atom transfer radical polymerization of lauryl methacrylate from initiator-functionalized silica and titania nanoparticles. Transmission electron microscopy (TEM) study showed that the interparticle distance increased with increasing brush molecular weight when hairy NPs were cast from dispersions in good solvents. These hairy NPs exhibited excellent stability in poly(alphaolefin) (PAO) base oil, and no change in transparency was observed after being kept at -20 and 100 °C for nearly two months. Their tribological performances were evaluated by high contact stress ball-on-flat reciprocating sliding tribological tests at 100 °C, which showed significant reductions in coefficient of friction and wear volume when 1 wt% of hairy NPs were added into PAO. The superior lubricating properties of hairy NPs were elucidated by the TEM characterization of the tribofilm formed on the flat from a tribological test.