Effective fullerene-based oil in high-performance lubrication

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Abstract

Given the increase in technology development the need for more energy efficient devices is required. In mechanical systems a large amount of energy is lost due to friction between sliding surfaces. For this reason, the creation of effective lubricants

is needed. Transition metal disulfides such as WS_2 and MoS_2 fulleroids have been used as oil additives to decrease friction coefficient, shear stress and wear between sliding metal surfaces. However, disulfides are prone to oxidation and release of sulphide compounds under heat and may corrode metal surfaces creating metal sulfides.[1,2] Carbon materials can exhibit higher chemical inertness and therefore exhibit longer lubrication lifetime under heat than transition metal disulfides. Among carbon materials; graphene, carbon nanotubes and fullerenes have been added into oil to decrease friction between two metal surfaces.[3,4] Unfortunately, the molecular interaction between carbon nanomaterials and lubricants has not been fully understood. We studied the molecular interactions between fullerenes and mineral oil, known as “nano oil”, by ultraviolet Raman spectroscopy, molecular dynamics simulations, and tribology measurements. The results indicate that aromatic molecules help to disperse individual $C_{60/70}$ molecules from aggregates whereas the alkane molecules help to stabilize fullerenes by forming a dynamic shell structure around them. Tribology tests of the “nano oil” revealed that the sliding metal surfaces can be greatly preserved and reduce the friction coefficient by half. Our findings demonstrate that fullerenes can be used as high-performance additives for effective lubrication, thus impacting different processes occurring in our daily lives.

References

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