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Functionalized Polymers and their Use as Oil-Compatible Friction-Modifier Additives: the Role of Polymer Architecture

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A novel design of oil-compatible lubricant additive has been synthesized and demonstrated to reduce friction on steel surfaces under a number of different oils. The basis for the friction reduction has been shown to be the formation of a "self-healing" polymer brush.

Keywords (from 3 to 5 max): lubricant additive, polymer brush, friction reduction

1. Introduction

To date, polymeric additives in oil have largely been used for their influence on bulk fluid properties, such as viscosity index or pour point. Additional positive surface effects, such as friction modification, have been shown for polymers functionalized with polar moieties [1]. The effects have been explained by the formation of thin films of adsorbed polymer on the polar surfaces in the mostly non-polar oil.

2. Polymer Brushes as Additives

Polymer brushes have been shown to reduce friction drastically, when attached to solid surfaces. This behavior has been observed in both aqueous media [2] and in oil [3], the former example being achieved by means of a brush-forming additive in solution, while the latter involved the growth of a brush layer prior to testing. To take full advantage of this effect in a practical, oil-based application, the brush would ideally self-assemble out of the oil solution, such that removal mechanisms during tribological stress would be compensated by a "self-healing", re-adsorption mechanism.

3. Novel Architecture

By means of designing a novel architecture, we have been able to synthesize polymeric, oil-soluble additives that form brushes, leading to a significant reduction in friction that does not diminish with time, i.e. it is self-healing. The synthesized polymers were chemically characterized by NMR, IR and GPC. Adsorption behavior was monitored by QCM-D and tribological assessment was performed by means of pin-on-disk, MTM and interferometric tests.

4. References

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