Advances of Superlubricitive Engineering

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Abstract

As the world's economy develops rapidly, losses caused by friction and wear in various fields increase accordingly, aggravating the energy crisis. According to statistical information, ~30% of the world's primary energy resources is consumed by friction and ~80% of the mechanical components fail because of wear. Based on different developing modes, frictional losses account for ~2%–7% of GDP per year, translating to ~1.7–6.1 trillion US dollars worldwide in 2019. How to reduce such large economic losses is a major challenge in tribology. Superlubricity may be an important option, which has been developing very rapidly in recent years. Many new phenomena, materials, and mechanisms in both liquid and solid superlubricity have been obtained. In the field of solid superlubricity, more materials with superlubricity have been observed, including graphene-to-graphene surfaces, highly oriented pyrolytic graphite to graphene surfaces, and heterostructure surfaces where a friction coefficient as low as 0.00004 has been obtained. In liquid superlubricity, many new kinds of liquids have been obtained, such water-based liquids, acid-alcohol mixed liquids, oil-based lubricants. A new system, i.e. solid-liquid combined superlubricity was proposed, which has high load capacity (up to over 1 GPa) in superlubricity. How to transfer superlubricity from scientific research into industrial application? "Superlubricitive engineering" will become a key work in the near future.

Keywords: superlubricitive engineering; superlubricity; liquid superlubricity; solid superlubricity; solid-liquid combined superlubricity