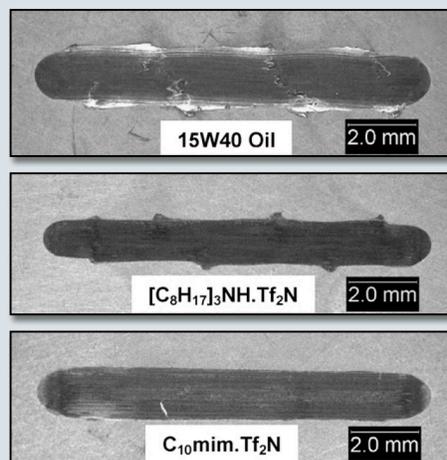


Ionic Liquids as Lubricants or Additives

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Wear Scars on Aluminum Lubricated by Oil and Ionic Liquids



Technology Summary

New ionic liquids invented at ORNL show great promise as lubricants for aluminum and steel in combustion engines, bearings, and microelectromechanical systems (MEMS). The ammonium-based ionic liquids are strongly adsorbant on contact surfaces, leading to a more than 30% friction reduction in metal-based interacting parts, compared with conventional 15W40 engine oil. This new class of lubricants can lead to dramatic energy savings: Friction and wear in machine parts costs the United States around \$700 billion annually.

Ionic liquids offer several other advantages. They have negligible volatility, high thermal stability, are nonflammable, and have intrinsic properties that eliminate the need for expensive lubricant additives. Room temperature ionic liquids are familiarly known as “green solvents,” and this invention broadens the set of applications as researchers show that ionic liquids/ammonium cations are potential lubricants or additives.

ORNL researchers prepare ionic liquids from ammonium salts of primary, secondary, and tertiary amines. The salts display good viscosities for lubricating surfaces at high and low temperatures, good thermal stability compared with mineral oil and conventional motor oils, and a low affinity for water. They have low melting points, generally below 25°C. While no wear reduction was observed with 100% ionic liquids, a mixture of mineral oil and 10% ionic liquid by volume resulted in lower wear than either a base oil or the 100% ionic liquid. This suggests a great potential for using them as lubricant additives.

Advantages

- Cost savings due to reduced friction and wear of mechanical parts
- Better friction reduction than conventional hydrocarbon oils

Potential Applications

- Combustion engines and bearings
- MEMS
- Metal forming

Patent

Jun Qu, Huimin Luo, John J. Truhan, Jr., Peter J. Blau, and Sheng Dai, *Lubricants or Lubricant Additives Composed of Ionic Liquids Containing Ammonium Cations*, U.S. Patent 7,754,664, issued July 13, 2010.

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