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Hydrophobic DESs as Alternative Lubricants for Tribological Applications

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PURPOSE OF THE ABSTRACT

The growing concern with environmental issues and the rapid development of nano and microelectromechanical devices (NEMs and MEMs) accentuated the need for more efficient and green lubricants. It is estimated that around 23% of the world's total energy consumption comes from tribological contacts, namely due to energy losses during the mechanical movements. Ionic liquids (ILs) have emerged as promising alternatives to the conventional lubricants, but they are very expensive to be used as pure lubricant. A viable solution to overcome this drawback is the use of ILs as additives to commonly used base oils or the use of (Deep) Eutectic Systems (DESs).

DESs are mixtures which show significant decrease on the melting point comparing to the original individual components due to the hydrogen bonding involving the large and asymmetric ions usually present.[1,2] They have recently been proposed as greener lubricant alternatives and demonstrated very good tribological behavior. [3,4]

In this work, we report the use of hydrophobic DESs based on combinations of salts and acids or natural components (the so called Natural Deep Eutectic Systems, NADES) to lubricate silicon surfaces. Since the water content may alter the mixtures properties, it is of extreme importance to assure that the DESs do not present a tendency to absorb water. All the prepared lubricants were characterized in terms of their water content, viscosity, wettability and tribological properties. The friction coefficients were measured using steel and silicon spheres against Si surfaces. The most promissory hydrophobic DESs showed a good tribological performance, both in terms of friction and wear comparing to commercial lubricant hexadecane making them very good candidates for future applications in NEMs/MEMs.

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FIGURES

FIGURE 1

FIGURE 2

KEYWORDS

Deep Eutectic Systems (DESs) | Lurbricants | NEMs/MEMs | Tribology

BIBLIOGRAPHY

[1] A.P. Abbott, G. Capper, D.L. Davies, H.L. Munro, R.K. Rasheed, V. Tambyrajah, Chem. Commun. 2001, 2010-2011.

[2] E.L. Smith, A.P. Abbott, K.S. Ryder, Chem. Rev. 2014, 114 (21), 11060-11082

[3] M. Antunes, A. S. Campinhas, M. Sá Freire, F. Caetano, H. Diogo, R. Colaço, L.C. Branco, B. Saramago, J. Mol. Liq. 2019, 295, 111728.

[4] M. T. Donato, L. Santos, H. P. Diogo, R. Colaço, L. C. Branco, B. Saramago, J. Mol. Liq. 2022, 350, 118572.