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Novel High Performance Lubricants for Industrial and Biomedical Applications

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The development of a new generation of lubricants is of paramount technological and economic relevance as it is estimated that half of our energy consumption is dissipated as friction.

Liquid Crystals (LCs) are anisotropic viscoelastic materials; the combination of fluid-like flow with crystal-like anisotropy makes its phases interesting as modifiers of interfacial behavior when applied as lubricants. The anisotropy of the viscosity coefficient, with respect to different flow directions, is a unique property of the liquid crystalline phase. The ability of liquid crystalline materials to form ordered boundary layers with good load-carrying capacity, and to lower the friction coefficients, wear rates and contact temperatures of sliding surfaces, thus contributing to increase the components service life and save energy has been widely demonstrated. Due to the bio-compatible nature of most lyotropic liquid crystalline materials, they have been considered as viable candidates to be used as bio-lubricants.

The computational modeling and experiments offer an efficient pathway to formulate novel lubricants which are economically viable. To improve lubrication efficiency we aim to develop a model of lubrication flow using liquid crystals or nanoparticles as additives that is experimentally validated and can be implemented into modern computational engineering and design tools.