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Amphiphilic surfactants as model additives for engine friction reduction

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The annual global cost of friction and wear is estimated to be €2.5 trillion and represents a significant energy loss. Organic friction modifiers (OFMs) are amphiphilic surfactants utilised to minimise engine losses with the aim of enhancing vehicle fuel economy. Conventionally, OFMs are thought to adsorb at metallic surfaces forming compact monolayer surface films. These reduce friction by creating planes of low shear resistance between contacting metallic surfaces.

It is challenging to reproduce the conditions found within a combustion engine and probe the interfacial structure of adsorbed OFMs in-situ. Therefore, much research so far has been conducted under static or mild conditions.

In this work, the self-assembly and interfacial behaviour of Ethomeen 18/12 (E1812) has been investigated through use of conventional techniques, neutron scattering, and an in-house, custom tribometer rig. This allows for in-situ neutron and X-ray scattering under sheared lubrication conditions.

Doping with water and small biofuel-related polar molecules has shown a strong effect on both micellisation patterns and friction-reducing performance. E1812 has been shown to adsorb at the iron oxide/dodecane-*d26* interface, forming layers of different thickness and degree of solvation depending on concentration and doping regimes. The behaviour of these solutions was also observed under shear, to follow the changes in lubricant film structure directly.

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