Influence of Surface Chemistry on Adsorption and Lubricity of Boundary Films

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In lubrication, and particularly in thin film lubrication with low viscosity fluid, the two antagonistic surfaces in contact are separated by a film of fluid less than a few hundred nanometres thick. This means that locally, due to the surface roughness, asperities from both surfaces can also interact. When sliding is introduced between the two surfaces, frictional dissipation results from a combination of shear of the thin film under pressure, shear of the adsorbed layers on the surfaces (called boundary layers or films) and shear of the interacting asperities. Therefore, surfaces play a key role in controlling friction dissipation.

An approach combining adsorption characterization and lubricity effectiveness of amine-based friction modifier molecules has been carried out using chemically controlled surfaces coated with either cobalt or carbon, while keeping the surface roughness constant and sub-nanometric. Through squeeze measurements and numerical modelling, we have identified the mechanical properties of both adsorbed amine films as a function of the surface on which they were formed. On the one hand, we were able to demonstrate that the fluid structuring in the vicinity of the adsorbed boundary film differs as a function of the latter's mechanical properties, as a direct consequence of its molecular organisation. On the other hand, we have shown that the coverage ratio of the monolayer, combined with the shear modulus of the boundary film, determines the level of friction.

We show here that the final boundary film organization, the correlated mechanical properties and the level of friction dissipation can be controlled by changing the surface chemistry while keeping the roughness constant [1].

[1] *F. Abouhadid, V-V. Lai, N. Morgado, D. Mazuyer, J. Cayer-Barrioz*, "The Effect of Surface Chemistry on the Squeeze-Thin film and Friction of Boundary Films", Langmuir, 40, 5205-5213, 2024. doi.org/10.1021/acs.langmuir.3c03409*