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Tribology and velocimetry experimental coupling: an original setup to study confined and sheared phospholipid layers

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Our main motivation is to analyze the deformation mechanisms of polymers in confinement from experimental measurements that ensure an in situ observation of the phenomena from yielding (scratches) to viscoelastic properties. In this vein, the behavior of the sheared interfacial layer when a spherical tip is sliding on a polymer surface still raises many questions. The main objective of this study is to initially model this unknown interfacial layer by phospholipid multilayers in a boundary lubrication case. Tribological experiments on these ultrathin films were performed to identify the influence of parameters such as temperature, relative humidity, sliding speed of the tip and applied mean contact pressure. For instance, an analysis based on Eyring model concludes that with an increase of humidity rate the value of the activation energy Q decreases. In parallel the clear influence of moisture on the thickness of water film in the structure of phospholipid layers was demonstrated with neutron reflectivity experiment. In particular, for three layers the thickness of water film between the supported bilayer and third floating monolayer can be ranged from 0.3 nm to 1.2 nm by increasing the moisture content from 30% to 90% (Figure). From these results the underlying question is how to determine the velocity profile and locate the slip plane in such a friction experiment. We propose to associate velocimetry and tribology experiments (Tribo-FRAPP) to have more information on microscopic level and on localization of sliding plane in the friction experiment. For instance, preliminary studies on DSPC three layers have shown that at low speed all three layers are moving and the slip plane whereas at higher speed only the third layer moves. In this case, the slip plane is located within the water film.

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