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Polymer-brush lubrication

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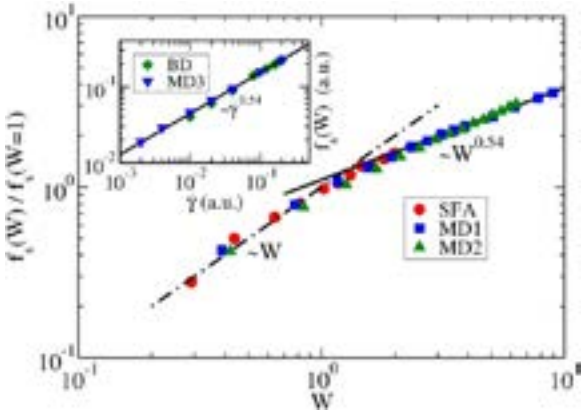
Polymer-brush bilayers consist of two opposing polymer-brush covered surfaces represent model systems for the investigation of lubrication mechanisms as they are believed to appear in synovial joints. Using scaling theory, I derive analytical expressions for compressive and shear forces which are essential for the minimization of the kinetic friction coefficient. The theory is compared to numerical data and data from the Surface-Forces-Apparatus (SFA) and the Atomic Force Microscope (AFM). As a further step, I discuss bilayers in highly non-stationary shear motion, such as the inversion of shear direction. Here, I show how data from molecular dynamics (MD) simulations coincide with the scaling theory. Once established for electrically inert bilayers, the approach is extended to polyelectrolyte bilayers and bilayers with macromolecular inclusions. By means of data from MD simulations, I demonstrate that such modifications do not improve the lubricity of the bilayer in stationary shear motion, but are of great importance with respect to highly non-stationary processes, which typically appear in synovial joints.



Rescaled shear stress as a function of Weissenberg number on double-logarithmic scales. The universal scaling plot allows for superposition of data from MD simulations, Brownian dynamics simulations and SFA experiments. Inset: Shear stress as function of shear rate.

Biography

Torsten Kreer studied Physics at University of Mainz, Germany, and received his PhD in 2002. Later, he moved to the Institute Charles Sadron in Strasbourg, France, for Post-doctoral studies. Since 2011, He is a Researcher and Leader of Non-equilibrium properties of polymers group at Institute "Theorie der Polymere"-IPF Dresden, Germany. He received several grants from the European Science Foundation (ESF-STIPOMAT programme) and the German Science Foundation. Apart from polymer brushes and their non-equilibrium properties, his main research interests cover polymers, colloids and their mixtures.

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