SPP 2171
Dynamic Wetting of Flexible, Adaptive, and Switchable Substrates

Impact of co-nonsolvency effects on dynamic wetting

People

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Abstract

For a good responsiveness of a substrate to external conditions, a distinct answer of the substrate to the stimulus is needed. In the proposed work, we want to investigate the changes in the dynamics of wetting of polymer brushes showing co-nonsolvency effects. The co-nonsolvency effect describes the counterintuitive phenomenon that a polymer can under certain circumstances become insoluble in a mixture of two good solvents under certain circumstances. Such substrates change from good solvent conditions (swollen state of the brush) to bad solvent conditions (collapsed state) in a relatively small range of solvent composition. These changes in the swelling state also induce changes in the dynamic wetting properties. The goals of this project are: (a) To study the statics and dynamics of the wetting of drops that induce swelling or collapse of the brush through co-nonsolvency effects(b) To investigated a potential competition of the solvent conditions between the gas phase and the drop or between two drops of different composition(c) To identify dominating dependencies and develop a physical modelTo achieve these goals, we combine various strategies. (a) Studying the dynamics of wetting in a broad range of well-defined contact lines velocities (from µm/s to tens of cm/s).(b) Combination of the wetting experiments with complementary experimental approaches (including imaging and spectroscopic ellipsometry to determine the brush layer thickness, AFM-based techniques for the mechanical characterization, and particle tracking methods to determine flow profiles).(c) Systematic variations of the experimental parameters, like the properties of the brush (grafting density, molecular weight, brush layer thickness), the time scales and contact lines velocities (see above), and the composition of the liquid (drop) and gas phase involved in the wetting. Brushes showing co-nonsolvency exhibit a richer response to solvent drops than normal (swellable) brushes. When the gas phase is in equilibrium to the liquid phase we have a tunable adaptiveness (through the composition of the gas and liquid phase) of the brush. When the gas and liquid phase favor different swelling states of the brush, a competition between both effects occurs and the co-nonsolvency (and its kinetics) interacts directly with the dynamics of wetting. The abovementioned combination of experimental methods will allow us to investigate the kinetics and dynamics of the system over a broad range of length and time scales. Specifically, we will use poly(N-isopropylacrylamide) (PNiPAAm) brushes prepared by a grafting-to method that allows for a well-defined molecular weight, grafting density and brush layer thickness.

Details

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References

1. Simon Schubotz, Christian Honnigfort, Saghar Nazari, Andreas Fery, Jens-Uwe Sommer, Petra Uhlmann, Björn Braunschweig, Günter K. Auernhammer

Memory effects in polymer brushes showing co-nonsolvency effects
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