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Structure and dynamics in functional polymer films

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Hydrogel films made from responsive polymers are able to switch between a swollen (extended polymer chains) and a contracted film state (coiled polymer chains) in response to slight changes in their surroundings. In recent studies, we demonstrated the versatility of a multi-responsive diblock copolymer, containing a zwitterionic poly(sulfobetaine) and a nonionic poly(N-isopropyl acrylamide) block, in thin-film geometry. With neutron scattering techniques such as time-of-flight neutron reflectometry and grazing-incidence small-angle neutron scattering (ToF-NR, ToF-GISANS), we identified discrete thin-film states, regarding their thickness, solvent content, and morphology, which can be precisely tuned upon changing external stimuli such as temperature, relative humidity, and the composition of the surrounding solvent vapor.
In future studies, we aim to use responsive biomaterials such as cellulose, as functional materials, due to their sustainability, biodegradability, high abundance, and low cost. Recent studies focused on the structural properties of cellulose nanofibrils during dynamic processes such as swelling and drying. For a fundamental understanding of their functionality, both the structure and the internal dynamics of the moieties are important. Therefore, these future studies will have a strong focus on the investigation of dynamical parameters using neutron techniques e.g., quasi-elastic neutron scattering (QENS) or neutron backscattering spectroscopy.

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