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Tuning PNIPMAM Thin Films for Application as Humidity Sensors: The Influence of Salt Addition

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Stimuli responsive polymers have gained much attention due to their unique properties. If polymer thin films exhibit a reversible volume change upon exposure to external stimuli such as temperature, pH, or solvents, they become promising candidates for applications such as nanoswitches or sensors. Polymers like poly(N-isopropyl methacrylamide) (PNIPMAM), which are sensitive to two stimuli can be used as bisensitive devices. PNIPMAM is a LCST-type thermoresponsive polymer and absorbs water molecules when it is exposed to water rich atmospheres. Due to low swelling times and strong volume changes upon water incorporation PNIPMAM thin films are of special interest. In this work, the influence of two different magnesium salts on the swelling behavior of PNIPMAM thin films is explored. In situ time-of-flight neutron reflectometry (ToF-NR) measurements are performed to investigate the macroscopic swelling behavior of the salt containing polymer thin films. By fitting the obtained reflectivity patterns, information about the distribution of the compounds vertically through the thin films can be deduced. To gain further insights on a molecular level and to understand the underlying hydration mechanism, additional in situ Fourier-transform infrared spectroscopy (FTIR) measurements are performed. Our studies showed, that the addition of different salts highly influences the swelling behavior as well as the hydration mechanism of PNIPMAM thin films depending on the salt additive.

Author: REITENBACH, Julija (Technical University of Munich, Chair of Functional Materials)

Co-authors: GEIGER, Christina (Technical University of Munich, Chair of Functional Materials); WANG, Peixi (Workgroup Polymer Interfaces, TUM Department of Physics, Technical University of Munich); CUBITT, Robert; SCHANZENBACH, Dirk; LASCHEWSKY, André (University Potsdam); PAPADAKIS, Christine (Technische Universität München, Physik-Department, Fachgebiet Physik weicher Materie); MÜLLER-BUSCHBAUM, Peter (Technische Universität München, Physik-Department, LS Funktionelle Materialien, James-Franck-Straße 1, 85748 Garching, Germany; MLZ, Technische Universität München, Lichtenbergstr. 1, 85748 Garching, Germany)

Presenter: REITENBACH, Julija (Technical University of Munich, Chair of Functional Materials)

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