Phase transition kinetics in a doubly thermo-responsive poly(sulfobetaine)-based block copolymer thin film

Lucas P. Kreuzer1, Tobias Widmann1, Lorenz Bießmann1, Nuri Hohn1, Johannes Pantle1, Raphael Märkl1, Jean-François Moulin1, Viet Hildebrand2, André Laschewsky2, Christine M. Papadakis1 and Peter Müller-Buschbaum1,4

1Technische Universität München, Physik-Department, Lehrstuhl für Funktionelle Materialien, James-Franck-Str. 1, 85748 Garching, Germany
2Helmholtz-Zentrum Geesthacht at Heinz Maier-Leibnitz Zentrum, Lichtenbergr. 1, 85748 Garching, Germany
3Universität Potsdam, Institut für Chemie, Karl-Liebknecht-Str. 24-25, 14467 Potsdam-Golm
4Heinz Maier-Leibnitz Zentrum (MLZ), Technische Universität München, Lichtenbergr. 1, 85748 Garching, Germany

the high versatility of responsive thin films

experimental design
diblock copolymer PSPP500-b-PNIPMAM50

UCST = 30°C
LCST = 50°C

measurement protocol

20°C
D2O swelling 20°C

1st Temp jump 20-40°C

40°C
1st Temp jump 40-60°C

60°C

flexiProbe @ REFSANS

flexiProbes sample environment

custom-made gasflow setup allows, tunable, reliable, and fast changing atmosphere compositions

horizontal TOF reflectometer with Gisans option

investigation of mesoscopic parameters such as film thickness and water content in-situ

phase behavior of the thin film

In-situ ToF-NR
(time-of-flight neutron reflectometry)

How does the film look like in equilibrium?
(states I, III, V, and VII)

state d [nm] SLD [10^-6 A^-2] ϕ_water [%]
I 76 0.8 0
II 101 4.1 60
III 158 3.5 80
IV 191 8.0 100
VII 76 2.7 37

ϕ_water (t) = SLD_water (t) - SLD_D2O


link to paper[3]

very fast and strong D2O swelling (diffusion limited)
collapse and re-swelling need much more time

ToF-Gisans
(time-of-flight grazing-incidence small angle neutron scattering)

changing thin film morphology upon increasing temperature