Experimental report

29/08/2022

Proposal: 9-11-1922 **Council:** 4/2019

Title: High pressure static and time-resolved studies on responsive polymer brushes

Research area: Soft condensed matter

This proposal is a new proposal

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Samples: poly(N-isopropylacrylamide) (PNIPAm)

Instrument	Requested days	Allocated days	From	To
FIGARO	2	2	22/01/2020	24/01/2020

Abstract:

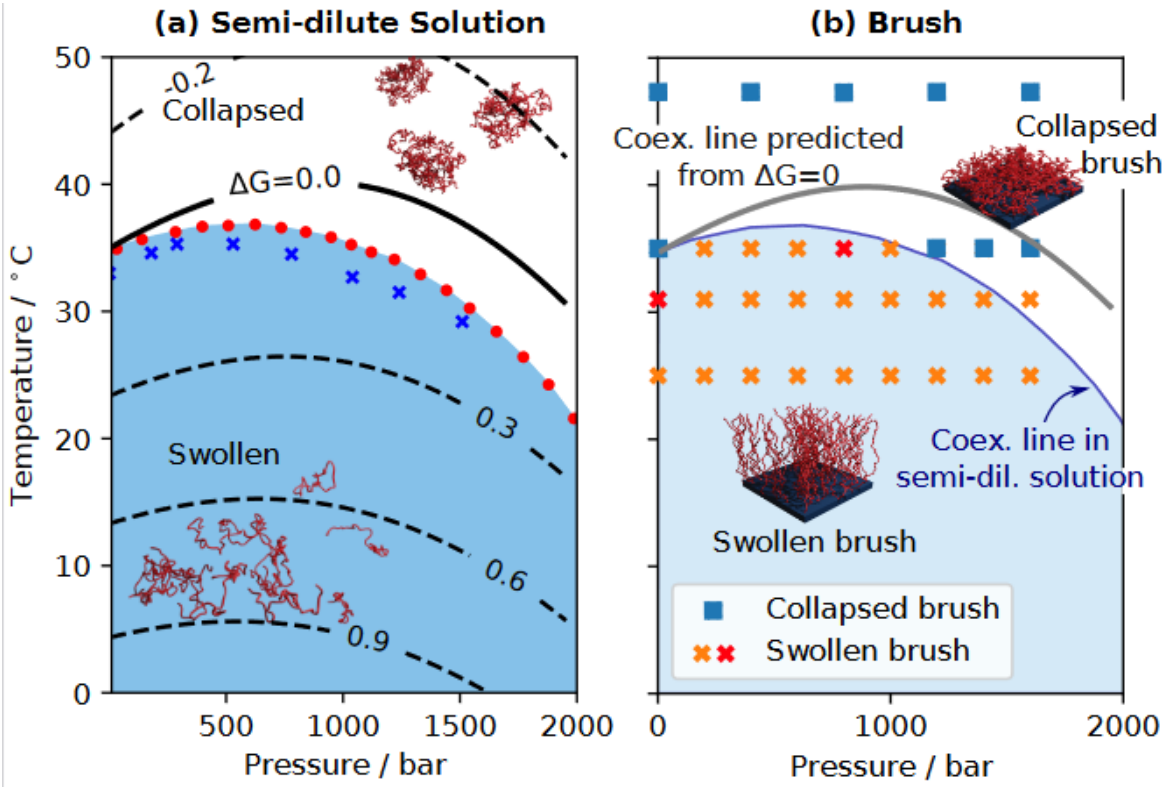
The pressure-responsive behavior of smart coatings is a largely unexplored area. In the proposed experiment, we will investigated a the response towards pressure of the well-studied thermoresponsive poly(N-isopropylacrylamide) (PNIPAM) brush. In addition to studying the static behavior of the brush under different hydrostatic pressure values, time-resolved experiments, aimed at depicting the phase-transition mechanism with a high time resolution, will be carried out.

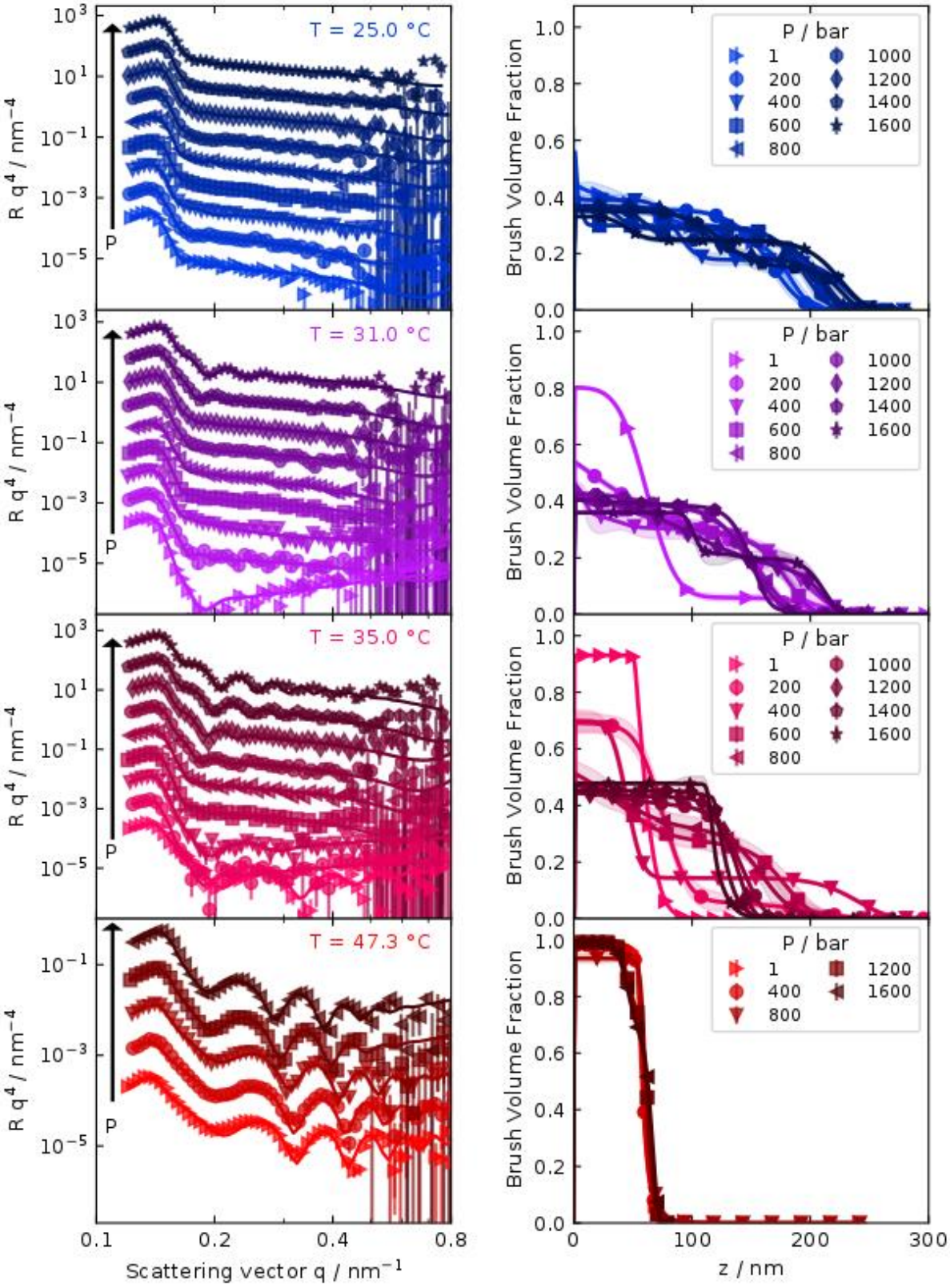
Experimental report for experiment: 9-11-1922 High pressure static and time-resolved studies on responsive polymer brushes

Aim of the experiment, was to determine the conformation of a PNIPAM polymer brush as a function of temperature and pressure. The high-pressure cell developed at TU Dortmund was used for the experiment. The planned time-resolved experiments could not be performed, due to the long acquisition time required (low transmission thorugh the sample cell, small sample size, and high resolution required for the experiment).

The experiment was very successful, and allowed to probe the phase behavior of PNIPAM brushes over a wide range of pressure and temperature values. The data have been analysed with different models, all leading to the same volume fraction profiles depicted in the next page.

Briefly, the analysis of the NR data shows that increasing the temperature induces a collapse of the PNIPAM brush, as extensively observed before. In contrast, increasing the pressure, induces a swelling of brushes. This phenomenon is particularly evident at temperatures close to the brush phase transition temperature. The data are compared in the figure below with the findings of PNIPAM dilute solutions, and with predictions made from knowing the derivatives of the free energy of collapse.




T = 25.0 °C
T = 31.0 °C
T = 35.0 °C
T = 47.3 °C
P
R q⁴ / nm⁻⁴
Scattering vector q / nm⁻¹
Brush Volume Fraction
z / nm
P / bar
1
200
400
600
800
1000
1200
1400
1600