Experimental report

16/09/2019

Proposal: 9-10-1570 **Council:** 10/2018

Title: Tuning the fast dynamics of PNIPAMmicrogels through the use of biologically relevant co-solvents

Research area: Physics

This proposal is a resubmission of 9-11-1865

Main proposer: Benedetta Petra ROSI

Experimental team: Andrea ORECCHINI
Benedetta Petra ROSI
Arianna D'ANGELO

Local contacts: Judith PETERS
Francesca NATALI

Samples: PNIPAM in D2O/glycerol-D8
PNIPAM in D2O/dimethyl sulfoxide-d6

Instrument	Requested days	Allocated days	From	To
IN13	9	9	13/06/2019	22/06/2019

Abstract:

PNIPAM microgels have been the subject of intense study for both academic research and technological applications, especially because of their remarkable thermoresponsiveness. Nevertheless, their picosecond dyanimcs at high concentrations remains largely unexplored. The only existing recent investigation on the dynamics of PNIPAM-based microgels in such high-concentration regime has revealed the presence of an interesting dynamic phenomenon on the picosecond scale. This effect, never observed before in these systems, interestingly resembles the so-called "dynamical transition" in proteins, where it is strictly related to the activation of biological functions. The role of the solvent interactions in driving the dynamical transition is particularly intriguing in this respect.
Here we propose to deepen the understanding of the fast dynamics in PNIPAM microgels and focus on the effects of the solvent by adding to water a specific cosolvent, i.e. glycerol or DMSO, known for the ability to modulate bio-related dynamics in proteins.

Experimental report – exp. 9-10-1570

For this experiment, 9 days of beamtime have been allocated at the IN13 backscattering spectrometer.

In this experiment, we measured the Elastic Incoherent Neutron Scattering (EINS) intensities of samples of PNIPAM (poly-N-isopropylacrylamide) in presence of water/glycerol mixtures with different proportions. Five samples were measured with the following composition:

1) PNIPAM:D_2O 1:1 weight ratio
2) PNIPAM:D_2O:d-glycerol 1:1:1 weight ratio
3) PNIPAM:D_2O:d-glycerol 1:0.35:1 weight
4) PNIPAM:D_2O:d-glycerol 1:0.15:1 weight ratio
5) PNIPAM:d-glycerol 1:1 weight ratio

Samples were measured in a temperature range between 150-320 K, with a temperature step ΔT ~10 K.

The incident wavelength was fixed at 2.23 Å, and the data were acquired in the Q-range bewteen 0.2-4.9 $Å^{-1}$.

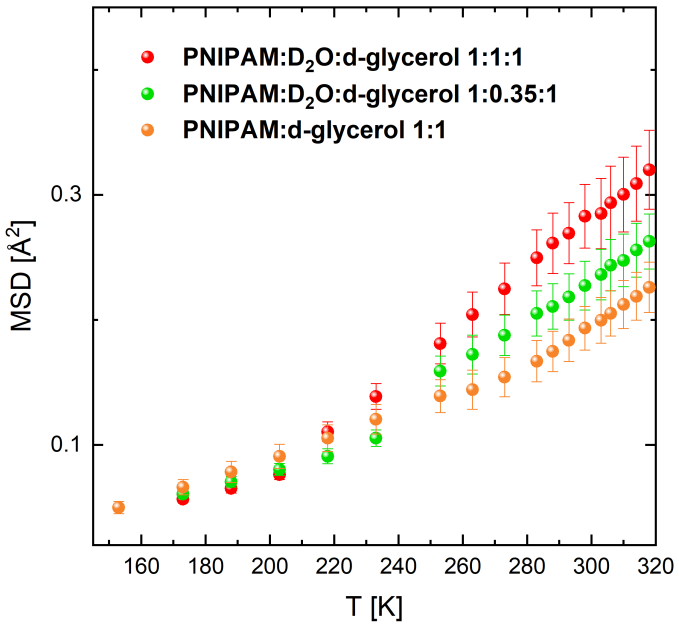

Figure 1. Mean square displacements (MSD) obtained by fitting EINS intensities of PNIPAM samples in presence of different water/glycerol mixtures, as a function of the temperature.