



	Experiment title: Static Correlations of Hydrophobic Polyelectrolytes	Experiment number: SC-711
Beamline: BM 26B	Date of experiment: from: 10 April 2000 to: 14 April 2000 (16 May 2000 17 May 2000)	Date of report: 1 Sept 2000
Shifts: 9	Local contact(s): Dr. Wim BRAS and Dr. Igor DOLBANYA	<i>Received at ESRF:</i>
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Report:

The general aim of this proposal was to identify the *structural changes and chain conformation of hydrophobic polyelectrolytes* by means of two combined techniques, static light scattering (SLS) and small angle X-ray scattering (SAXS). Some SLS results have been

reported elsewhere, especially those in the thermodynamic limit ($q = 0$) where the scattering intensity could be compared to direct osmotic pressure measurements [1]. SAXS studies were performed on beamline BM-26B. For this purpose a series of sodium poly(styrene-*co*-styrene sulfonate) of various charge fractions ($f = 0.47, 0.57, 0.75, 0.92$) was studied in a wide scattering range, i.e. from 7.7×10^{-4} to $8.1 \times 10^{-2} \text{ \AA}^{-1}$, allowing us to determine the relevant characteristic scattering lengths. While keeping constant the number of monomers ($N = 6400$), our system was studied as a function of electrostatic charge f and number density of chains, •••All our experiments were carried out without added salt. The complete scattering profiles show two general characteristics:

- a correlation peak in the high q part giving access to a correlation length •
- a sharp upturn of almost two orders of magnitude in intensity at lower wave vectors allowing us to deduce an apparent radius of gyration R_g .

A detailed analysis of data has allowed us to show that the strong intensity at low q 's is not due to the presence of impurities or of very large aggregates in the system, as often claimed, but is related to the conformation of the chains. We confirm that there are important structural changes as a function of hydrophobicity (and charge content), identified as the appearance of pearl-like structures, which influence the complete scattering profile. Contrary to common belief, the chains are not very extended and strongly entangled but rather have a gaussian conformation at large scale and are only slightly entangled at the investigated concentrations. Even if the static structure factor in the thermodynamic limit has to be relatively small (due to the high osmotic pressure), the scattered intensity is dominated by the structure of the chains, through the polarisability [1]. Also the correlation peak must have an important contribution of the interacting pearls belonging to the same chain. This picture agrees qualitatively with the results of recent simulations [2] but differs slightly from the current model for semi-dilute solutions of pearl necklace chains [3].

A paper reporting these results should be submitted shortly.

References

- [1] M.D. Carbajal-Tinoco and C.E. Williams, *Europhys. Lett*, accepted for publication.
- [2] U. Micka, C. Holm and K. Kremer, *Langmuir* **15** 4033 (1999)
- [3] A. V. Dobrynin and M. Rubinstein, *Macromolecules* **32** 915 (1999)

