ESRF	**Experiment title:** Decay of interface correlation in thin polymer films	**Experiment number**: SC-510
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Report:

We have investigated the surface morphology of thin polymer films on top of silicon substrates as prepared by spin-coating and after annealing. As model system we used polybromstyrene $P(Br_xS)$ with a degree of bromination of x=1.07 with a molecular weight M_W = 145000 g/mol .
With **static measurements** the part of the correlated roughness spectrum is examined as a function of the film thickness. Due to the chosen set-up (Si(111) analyzer crystal together with a linear position sensitive detector) a large q-range is accessible which enables the determination of roughness correlation down to extremely small film thicknesses. In addition the q_y-resolution is very high. Figure 1a shows one measured intensity mapping in a contour plot representation as an example. The exit angle is denoted with α_f and the in-plane wave vector with q_y. Note that α_f covers a range of more than 4° and that the incident angle is α_i =1.18°. The thickness of the measured sample shown in figure 1a is 30 Å and thus small compared to the radius of gyration of the unperturbed molecule (100 Å). As a consequence these films are strongly influenced by confinement effects. We observe an enhancement of the diffusely scattered intensity originated by correlated roughness (intensity streaks parallel to the q_y-axis in figure 1a). In addition the Yoneda-streak is visible. Due to the large surface roughness of 25 Å no specular peak is detectable.

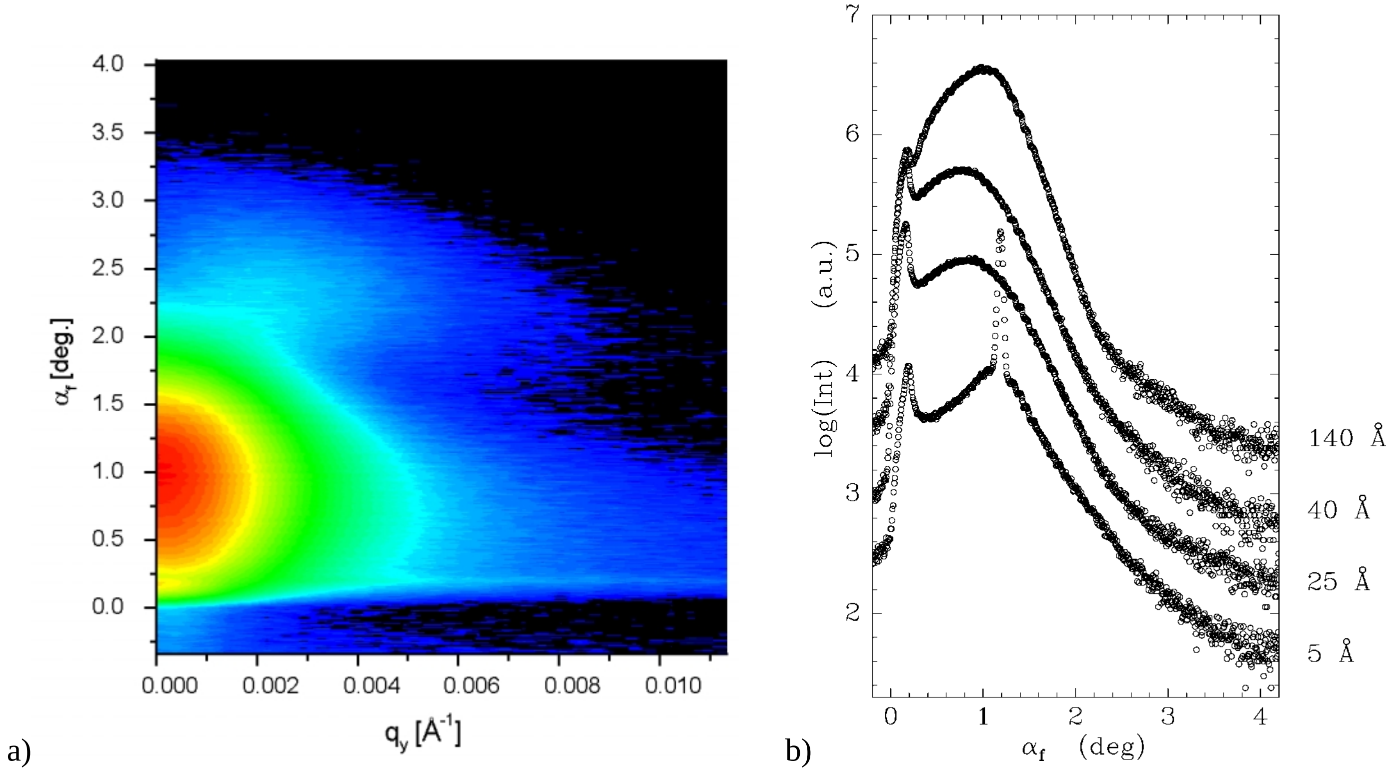

Figure 1: *a) Contour plot of the diffusely scattered intensity. The resonant diffuse scattering enhances the intensity in narrow regions of the reciprocal space which are oriented paralle to the q_y-axis. b) Cuts at q_y=0, frequently called detector-scans showing the Yoneda-peak, the specular peak and modulations in the intensity due to resonsnat diffuse scattering. The wavelength of the modulation is determined by the thickness d of the correlated film $\Delta q_y=2\pi/d$.*

In figure 1b the influence of the surface rms-roughness σ of the underlying substrate on the long range correlation is pictured. While at small values of σ=5 Å a specular peak is observed, for larger values only diffusely scattered intensity was measured. Independent of the value of σ the scattering curves show modulations due to resonant diffuse scattering. In case of the σ=5 Å sample the specular peak sits on top of the maximum of the diffusely scattered intensity. Consequently in the detector scan the intensity modulations are burried by the tails of the specular peak, whereas in off-detector scans ($q_y \neq 0$) they are clearly visible.

In addition to the static measurements **kinetic measurements** were performed. The samples were annealed above the glass transition temperature and the changes in the diffusely scattered intensity were measured in-situ. From these data the decay of the transferred part of the roughness spectrum is resolved and the loss of this long range correlation is monitored in real time. The results pictures the formation and dynamics of capillary waves at the sample surface and probes the mobility of polymer chains in confined geometry. This provides important information for the interpretation of interdiffusion experiments. A detailed data analysis of the kinetic measurements is in progress.