ESRF	**Experiment title:** Tracking sub-micron assembly in single-domain polymer opals	**Experiment number**: 26-02-573
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Report:

The measurements are performed using the photon energy of 12.4 keV. Due to problems with the lens setup and rather low scattering contrast of the opal films, no compound refractive lenses were used in this experiment. Instead, careful beam focusing at the detector position was performed by bending the second crystal of the monochromator and the mirror.

Polymer opal films with different degrees of structural order as well as different ordering techniques have been characterized. Clear SAXS patterns were observed on polymer opals which are comprised of pure polymeric spheres embedded in medium of a different polymer with very low electronic density contrast between them. Samples were scanned in the (x,y)-plane with a single orientation (normal incidence) to access film uniformity. Although some variations are observed, the diffraction patterns measured at different positions were rather similar and had the same azimuthal orientation, which is predetermined by the ordering process. To access the 3D order the high-resolution SAXS measurements are performed with different sample orientations for different samples at a pre-selected (x,y)-position.

The results show that before applying the ordering process, the structure of the film is completely disordered (Fig 1a) but do show pronounced rings presumably originating from (short-range) positional correlations between the particle positions. Clear crystalline features appear after applying the ordering process, then these features become more and more significant with increasing number of the ordering passes (Fig 1b-1f) which indicate better structural order and alignment. In order to analyze stacking order of the close-packed planes, SAXS patterns were taken from different angles by rotating the sample (Fig.2). Careful analysis of the data will help us understand more about how the spheres rearrange from jammed state to crystalline structure under shearing force.

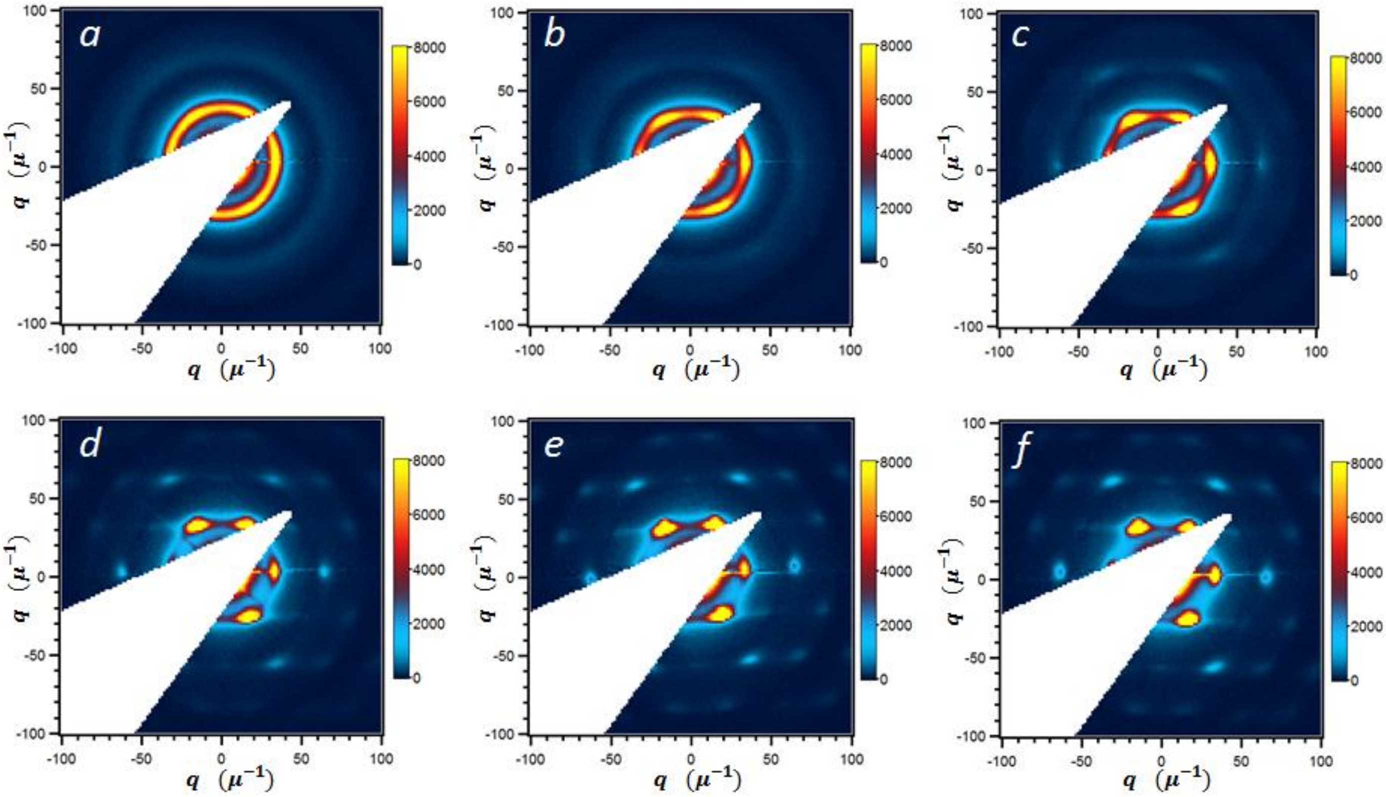

Figure 1. 2D SAXS patterns of polymer opals before and after different passes of ordering process. (a), before ordering, (b), 1 pass, (c), 5 passes, (d), 10 passes, (e), 20 passes, (f), 40 passes.

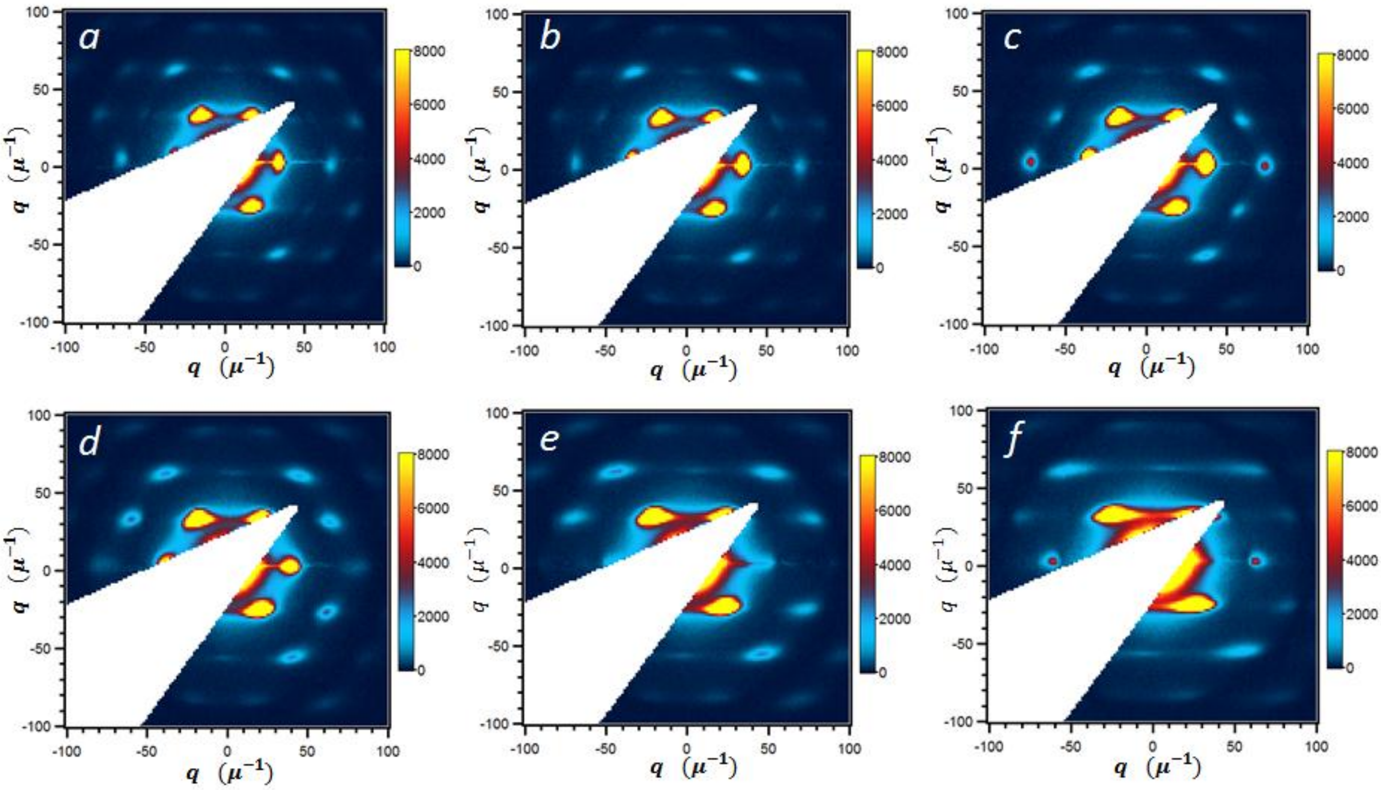

Figure2. 2D SAXS patterns of polymer opal film ordered with 40 passes at different rotation angles. (a) – (f), 0˚-50˚, with 10˚ increment.