Report to the beam time SC-3705:

Growth Kinetics of Two-Dimensional Polymers at Air/Water Interface by Grazing Incidence Small-Angle X-ray Scattering and Wide-Angle Diffraction

The main goal of the proposed project is to quantitatively determine the growth structure kinetics of two-dimensional polymers at the air/water interface perpendicular and parallel to the sample surface. The combination of grazing incidence small angle X-ray scattering (GISAXS), and grazing incidence X-ray diffraction (GID) is used to investigate the polymer structure parallel to the sample surface while specular X-ray reflectivity (XRR) is used to extract the perpendicular structure of the polymer monolayer.

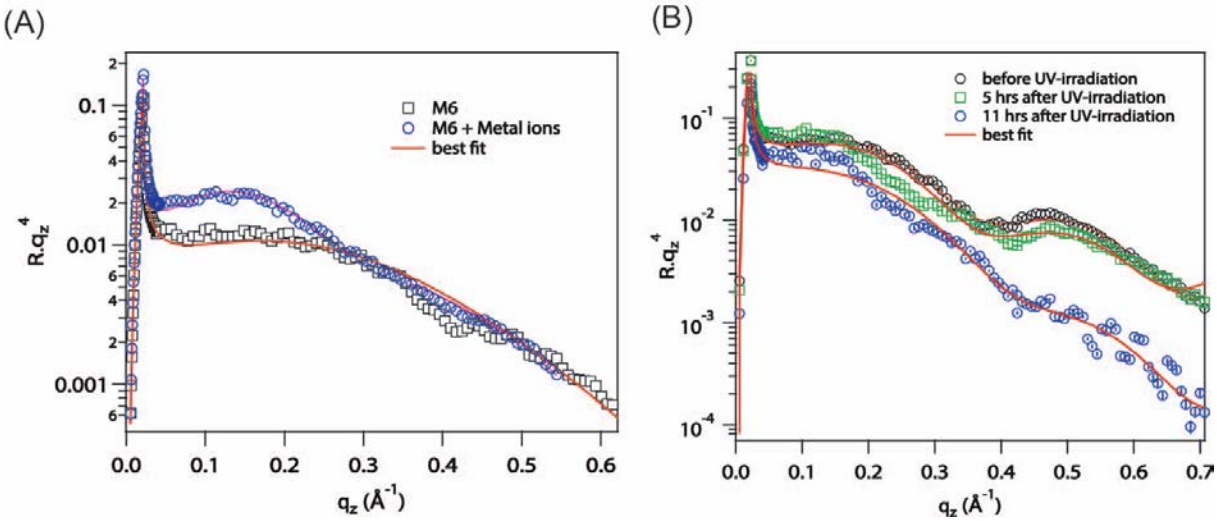

Fig. 1 (A) *X-ray reflectivity of a monolayer of monomer with six-fold symmetry (M6) before (black squares) and after (blue circles) the addition of Zn(OTf)2. X-ray reflectivity of UV-induced polymerization of a monomer with three-fold symmetry (M3) before (black circles) and after UV-irradiation with 5 hours (green squares) and 11 hours (blue circles) exposure time. The best fits indicated in solid red lines.*

XRR results for the metal ion mediated polymerization (figure 1A) showed that the M6 monomer monolayer at the air/water interface after the addition of metal ions (*Zn(OTf)2*) exhibited an increase in the monolayer thickness (~ 5 Å to 18 Å). This suggests together with the chemical structure of M6 monomers that the M6 monomers changed its confirmation after the addition of metal ions giving an access sites which facilities the ions-monomers complexation.

XRR data of UV-radiation induced polymerization is shown in figure 1B. The XRR results show that the M3 monolayer after UV-irradiation retains its thickness and electron density even after 11 hours of exposure time while the monolayer interfacial roughness increases with increasing the UV-exposure time. This is an indication of the formation of polymer patches at the air/water interface which leads an increase of X.ray diffuse scattering at the interface.

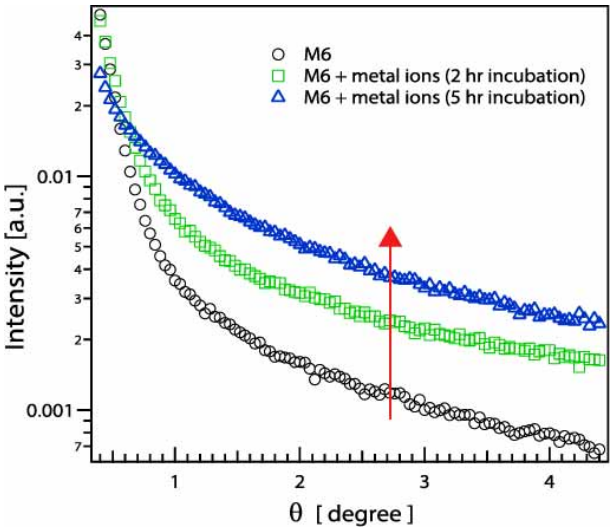

Fig. 2 *GISAXS measurements of M6 monomer monolayer before (black circles) and after the addition of $Zn(OTf)_2$ with 2 hours (green squares) and 5 hours (blue triangles) of incubation time.*

Figure 2 represents GISAXS measurements of M6 monomer monolayer before (black circles) and after the addition of metal ions with 2 hours (green squares) and 5 hours (blue triangles) of incubation time. The measurements show that the scattered intensity increases with the incubation time (indicated by red arrow). This suggests as mentioned above the formation of polymer domains at the air/water interface.

However, in order to finalize the results into publishable form an optimization the experimental procedure is required. For example, adjusting the initial surface pressure of the monomer monolayer is a crucial factor that determines the quality of the two-dimensional polymer formation. In addition, the performed experiments suggests that the scattered intensity improved by more incubation time with metal ions. Therefore, increasing the time of incubation will give higher chances for a clear GISAXS signal from the monolayer.