ESRF	**Experiment title:** Structure and long-range order of a porphyrin template on KAP	**Experiment number**: 26-02-416
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Report:

Structure determination of proteins is predominantly achieved using X-ray crystallography. The main bottleneck in this process is the growth of protein crystals of sufficient size and quality, and finding methods to improve the growth is an important research area. One method we are investigating is the use of supramolecular templates as a means to grow both 3D and 2D protein crystals. Membrane proteins are notoriously hard to crystallise, and templates are an interesting route to provide a long-range ordering field in which high-quality 2D crystals can be grown.

As a first step in this project, we need to make highly-ordered templates, i.e., with large domains and small mosaic spread. The system we have chosen is porphyrin molecules on Potassium Acid Phthalate (KAP) substrates with (010) orientation. We have first studied this system using AFM, growing the porphyrin layers from a heptane solution. Based on this we expect a monolayer of porphyrin to adhere at the surface at undersaturation conditions. For sufficiently high supersaturation, epitaxial needles are formed, with an orientation that depends on that of the monolayer.

We designed and built a special in situ cell made from PMMA for the experiments in order to work under clean conditions. The first experiments were done with the cell filled with heptane and with heptane-porphyrin solutions. These gave quite low signal-to-noise ratios, therefore we decided to work with thin films of solution. Such films are formed when working under conditions with 100% saturated heptane vapour.

The signal-to-noise ratio improved considerably. The specular ridge scan cleary showed the presence of a 4 nm thick fluid layer of heptane. When the experiment was repeated with a solution of porphyrins in heptane, no film was found. When, however, the crystal slightly touched the solution, again fringes of a fluid layer where found. The thickness of this layer and thus the positions of these fringes was found to depend on the amount of substrate in the solution and the history of the sample. The films were thicker than the one in 100% heptane vapour. Except for the fluid layer fringes, there were no evident differences between the specular rods of pure heptane and the porphyrin films (Figure 1).

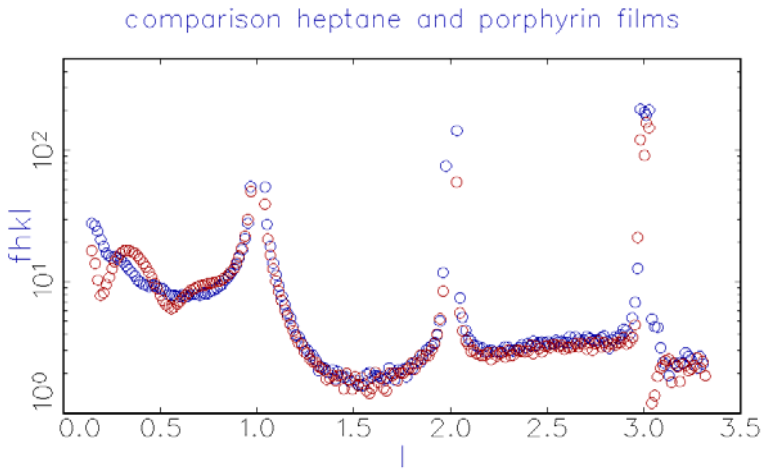

Figure 1:specular ridge scans for pure heptane(red) and porhyrin solution (blue) films on KAP.

For the porphyrin film, a complete data set with several symmetry equivalent rods was measured. The data for the other rods still has to be examined, but we expect no differences, because the specular rod should be the most sensitive for that.

Finally, on a dry sample with nanoneedles, reciprocal space scans were done and in this way we determined the spacing in the *l*-direction and and the *h*-direction, as shown in Figure 2.

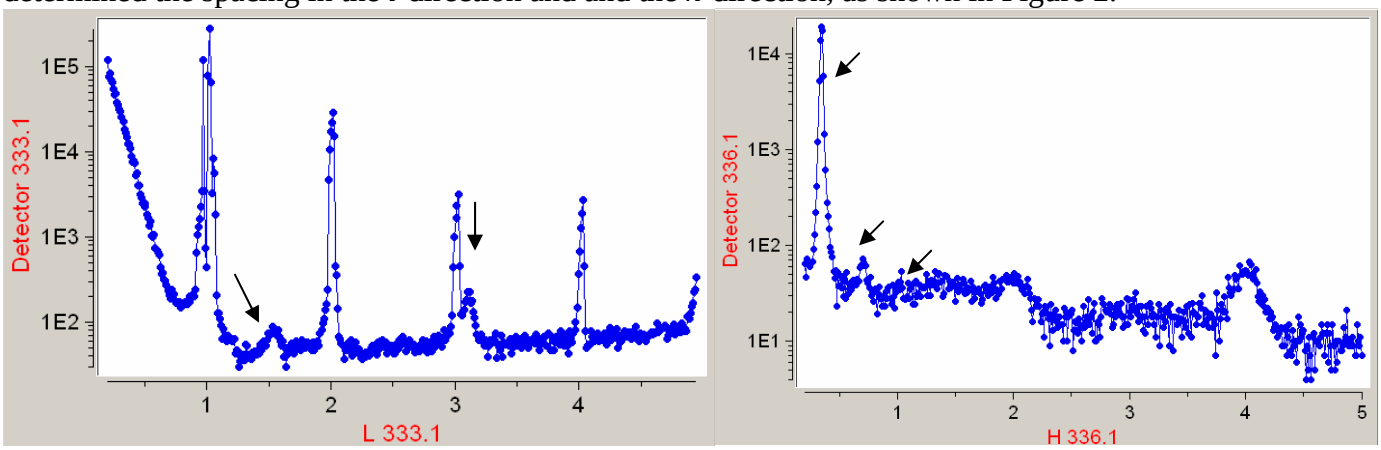

Figure 2 Scans along l- and h-direction of porphyrin nanoneedles on KAP. The arrows indicate the Bragg peaks from the porphyrin.