4.2 In-situ Investigation of the LB Film Transfer Mechanism onto Solid Substrates Using the Langmuir-Blodgett and the Langmuir-Schäfer Method

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The mechanism of LB film transfer onto solid substrates was investigated using both the vertical dipping (Langmuir-Blodgett, LB) and the horizontal dipping method (Langmuir-Schäfer, LS). In the LB technique, the substrate is dipped perpendicularly to the water subphase providing the possibility of multilayer film deposition. The wetting properties of the substrate in use with respect to both the water and the liquid-like solution of LB molecules, are essential for a successful LB film transfer. Therefore, a down-stroke with a hydrophilic terminated sample surface will result in no (or very few) film transfer, while a hydrophobic surface would wet completely. Furthermore, the interfacial tension γ_{sl} during film deposition induces a local force gradient parallel to the dipping direction.

In the LS method, no such force gradients are present since the substrate is lowered parallel to the water surface. Deposition occurs whenever the sample surface touches the outermost methyl-groups of the outstanding Langmuir film. The sample is then withdrawn pulling out a Langmuir monolayer. However, this method is not convenient for multilayer deposition, and therefore serves for comparison, only.

We prepared floating Langmuir layers of the DCANP type (2-docosylamino-5-nitropyridine) which has been extensively investigated in the past with respect to its structural and optical properties. First, we found that both the LB and the LS method are well suited for film transfer. The LB technique, however, induces reorientation of the chromophore head-groups as can be measured in the SHG anisotropy on transferred DCANP LB films (anisotropy factor of 1:10). This process stems from the non-uniform force gradients when pulling the LB molecules out from the water subphase (contact angle). The LS method, in contrast, provided exactly the same optical and structural features as was observed for the floating Langmuir monolayer.

The transfer process was investigated in direct space making use of our newly developed polarisation and SHG techniques. We were able to image the DCANP monolayer right at the edge when it is transferred from the water subphase onto the pyrex substrate. This illustration is added below in Fig. 1 and demonstrates the uniaxial alignment of DCANP molecules along the dipping direction as soon as they make contact to the substrate surface.

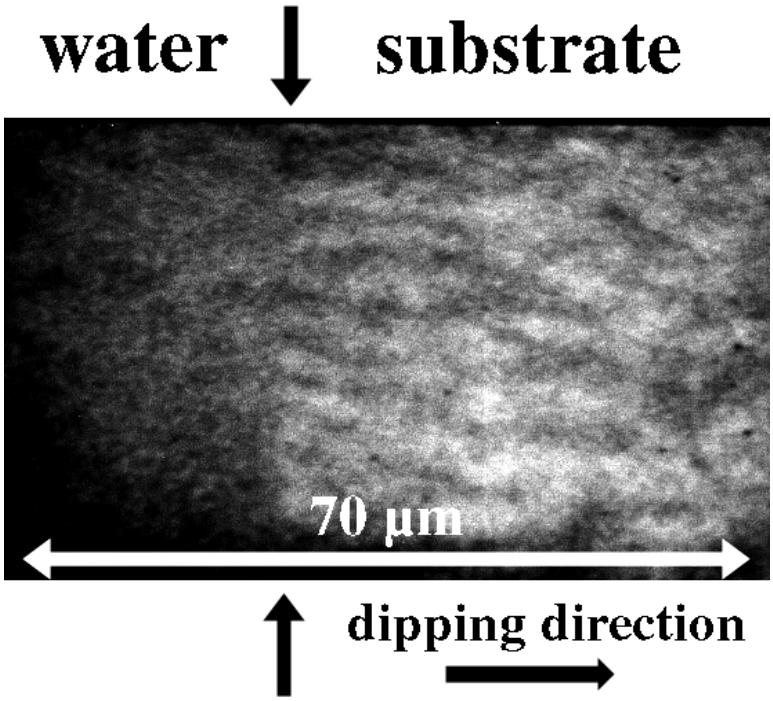

Fig. 1 Film transfer of LB molecules from water subphase (left) to the substrate (right) reorients the LB molecules parallel to the direction (see arrow)