ESRF	Experiment title: Etude de la structure de coeur de défauts smectiques par diffraction des rayons X *Study od smectic defects cores by x-ray diffraction*	**Experiment number**: 02-02/ 768
Beamline: D2AM	**Date of experiment**: from: 08-09-2010 to: 15-09-2010	**Date of report**: 19-10-2009
Shifts:	**Local contact(s)**: N. Boudet	*Received at ESRF:*

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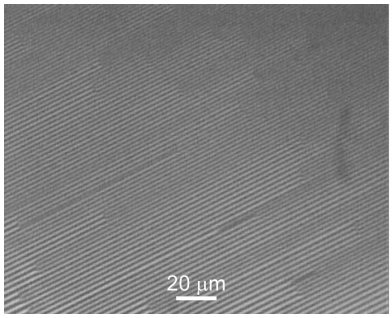
We study the core of defects in lamellar compounds. This job of fundamental type also has an applied sense, given that we develop an ANR project in parallel, called « nano-particles and liquid crystals », in order to trap nano-particles within defects, fine structure of which it is necessary to know. For these studies, we self-organize «oily streaks» of 8CB on substrates, leading to a planar unidirectional anchoring while, at the air/interface, anchoring is orthogonal (homeotropic) [1, 2]. The antagonism of anchoring imposes the self-organization of defects, disclinations and grain boundaries (figure 1a). Using the experiments of May, 2009 performed on CRG-D2AM (ESRF) [3], we showed how, on mica, within a smectic film of 8CB, the structure of defects changes very close to the substrate (on the first hundreds of nm), in comparison with the classical model [2] (fig. 1b). The presence of a virtual disclination is evidenced for instance, what very differs from what is found on substrate of MoS_2, where the disclination is transformed into rotating grain boundaries of extension 100 nm [4]. It seems therefore that interaction between substrate and defects take place, which consequently varies with the nature of interface. During the experiments performed in september 2010, one month ago, we had to goal : confirming the presence of perpendicular layers, close to the substrate, in agreement with the model issued from experiments performed in may 2009 (figure 1b) [3] ; starting a study on other substrates of rubbed polymer. These substrates, besides their fundamental interest, are of interest to be very broadly used in screens based on liquid crystals. As regards the fundamental aspect, fact that they are not crystalline and therefore do not induce ordered interface makes them very supplementary of crystalline substrates with the intention of understanding the role of defect/substrate interaction.



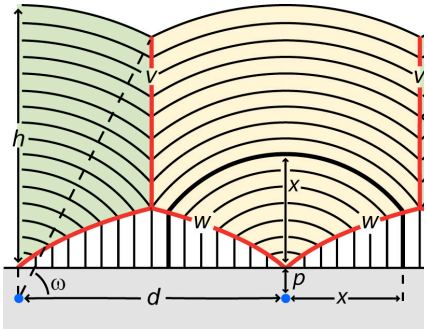


Fig. 1(a). optical microscopy image of a smectic 8CB film on mica

Fig. 1(b) : Model of oily streaks structure on mica, as the result of fitting of experiments in « reflection geometry ».

During the D2AM experiment of September, 2010 (September 8th - 15th), we therefore set up a « transmission set-up », including a 2D detector, which we tested on the system 8CB/mica (fig. 2). In agreement with the model of figure 1b, we measured a bigger number of perpendicular layers in comparison with the layers which turn. However, we also evidenced that this set-up is not perfectly adapted to thin films, due to the background noise, comparatively larger in the transmission set-up compared to the reflection one, and due to the larger evolution of the irradiated samples in the transmission set-up, which requires regular checks on evolution under X-ray beam.

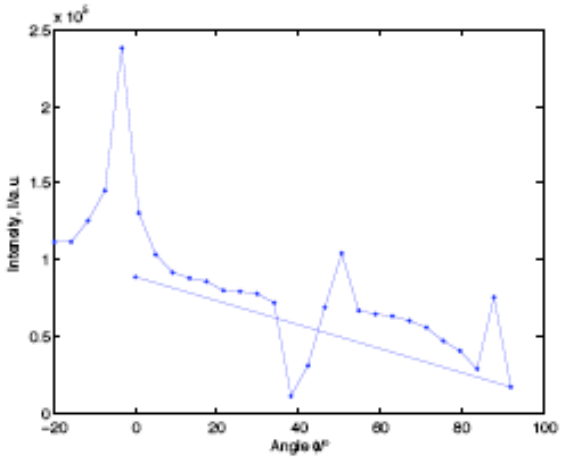


Fig. 2 : X-ray signal evolution with the smectic layers orientation, demonstrating the presence of one peak associated with perpendicular layers at φ =0 (around φ = 39°, the pronounced dip corresponds to the furnace tungsten pillars passing in the direct beam).

In a second step, we used the same “transmission set-up” in order to test the detection of oily streaks on rubbe polymer (Polyimide and PVA). We revealed that the perpendicular smectic layers are present as well as th smectic layers which turn. Unfortunately, due to the fact that experiment is very recent, data are still nc quantitatively analyzed. However, on one hand, these films differ from those on mica, with « t » grain boundarie of smaller extension which make them thinner (fig. 1a) which finally leads to a smaller x-ray signal detected. O the other hand, background noise led by the glass is practically one order of magnitude larger than the one o mica. Consequently, if it already appears clear that “transmission set-up” is necessary to evidence perpendicula layers which are "hidden" by the 8CB critical angle ($\theta_{8CB} = 0.17°$) in « reflection geometry », it also appears clea that measurements in « reflection geometry » are mandatory to obtain enough resolution for a precis determination of layers rotation. Only the combination of both measurements on the same sample will finall allow to determine the structure of the defects close to rubbed polymers.

Références

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[2] B. Zappone et E. Lacaze, Phys. Rev. E **78** (2008) 061704.
[3] B. Zappone, E. Lacaze et al., soumis à Soft Matter.
[4] J. P. Michel, E. Lacaze et al., Phys. Rev. Lett. 96 (2006) 027803