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Study of liquid crystal in contact with aqueous solutions for detection of biomolecules

K. Neyts¹, J. Da Silva¹, H. Desmet², H. Azarina¹, I. Bartolozzi³, and E. Schacht³

¹Electronics and Information Systems, Ghent University, Belgium

²Electronics and Information Systems (ELIS)/ Information Technology (INTEC), Ghent University, Belgium

³Department of organic chemistry, Ghent University, Belgium

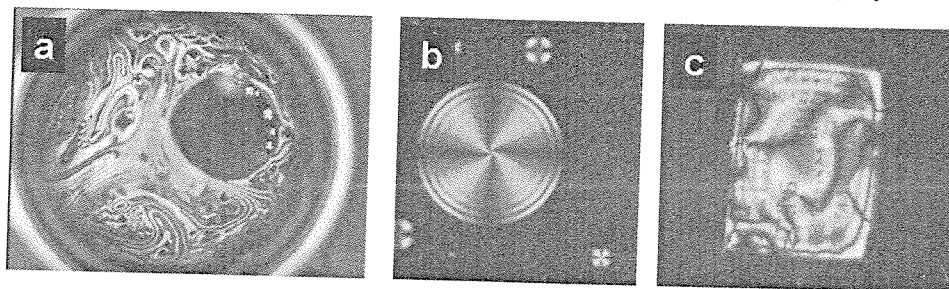
The interface between liquid crystal (LC) and an aqueous solution can be used as a substrate for the recognition of biomolecules. Intermolecular interactions at the different boundaries of the substrate / aqueous solution / liquid crystal / air system determine the surface tensions and LC alignment, which lead to different macroscopic behaviors. In this paper we present results obtained with combinations of different surfaces (glass, rubbed polyimide on glass, surfactant-coated glass, chemically bound mesogenic molecules on glass, structured silicon) and different nematic liquid crystals (E7, 6CHBT). The goal of these investigations is to assess the importance of surface tension, flow, surface viscosity and monolayer formation in phenomena like wetting, hole filling, anchoring and defect topology.

At the water/air interface different kinds of liquid crystal structures have been observed. Because the surface tension of the water/air interface can be reduced by an intermediate LC layer, liquid crystal spontaneously covers the water surface with a thin layer. The behavior of LC on water is in many respects similar to that of free-standing LC films. There is no memory of the anchoring and because of hybrid alignment (planar for water and homeotropic for air) the director can freely rotate over the water surface. Stable thin layers (microm. range) with Schlieren-textures are observed (figure a). We attribute the black region in figure a to an invisible liquid crystal layer. It is present if the LC layer is stretched out sufficiently. In this thin layer, lens-shaped LC droplets can be embedded (figure b), with elementary director geometries. From these droplets, the contact angle of the liquid crystal E7 on water could be determined as 3 degrees.

Different routes for obtaining stable amounts of LC on a substrate under water have been investigated. One is to use a structured silicon substrate with holes, filled by liquid crystal before coverage with water (figure c). Another way to reduce the surface tension between the surface and a specific liquid crystal is to chemically bind liquid crystal molecules onto an aminosilanized glass surface. This has been realized successfully with 6CHBT.

The results presented here offer possibilities for interaction between biomolecules solved in aqueous solutions and the surfaces of liquid crystals.

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ABSTRACTS

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