Tunable porous membranes in nematic liquid crystals to drive colloidal assembly by bulk topological defects

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The control of colloidal assembly mediated by elastic interactions in anisotropic fluids has been the object of an increasing number of studies. One recent result has shown that an ordered colloidal assembly at the nematic liquid crystal (NLC)-air interface can be driven by the interaction of the topological defects associated to the colloids with the bulk defects induced by arrays of microposts [1]. Therefore, the possibility of tuning bulk defects to tune colloidal assembly at the interface seems worth pursuing.

The tunable bulk defects are provided by PDMS membranes patterned with arrays of holes and immersed in NLC 5CB. The swelling of the PDMS membrane induces a fully reversible pattern transformation, with the round pores switching to elongated pores with alternate vertical and horizontal orientation (Fig.1), a behavior similar to that observed in hydrogels [2].

![Fig.1: Bright-field image of PDMS membrane swelling and undergoing pattern transformation under a drop of solvent. The diameter of the pores is 10 μm.](image)

Due to the weak homeotropic anchoring of 5CB on PDMS, various types of distorted defects are formed under pattern transformation, ranging from elongated disclination loops to “split” hedgehogs.

The best control over the pore shape and anisotropy is achieved by stretching the PDMS membranes. In this way, it is possible to precisely control the distortion of the topological defects, and, consequently, to modify the arrangement of colloidal particles at the NLC-air interface.

References:


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