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Confinement Effects on the Structure of Complex Fluids

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Actin is a key component of the protein complex responsible for producing contractile force in skeletal muscle. Filamentous actin, called F-actin, is a two-stranded helical protofilament with a diameter of ∼8nm and a contour length of ∼10m. The experimental results show that the persistence length of the F-actin is 4 -20 m. One of interesting problems is to find the structure of a semiflexible filament in a confined space [1], such as a channel width less than the persistence length. The other interesting problem is to find the surface treatment effect on the liquid crystal structure in a confined space. The boundary conditions imposed by the walls of the microchannel generate the spatial patterning of defect domains in a smectic liquid crystal [2] and the formation of a large-area ordered structure [3] by using the structure of smectic liquid in the microchannels. We found that the F-actin undergoes a transition from a 2D randomly oriented regime to a 1D biaxially confined regime with the effective persistence length. We were able to generate defect domains that are nearly uniformly arranged in 2D ordered patterns by controlling the surface hydrophobicity. Furthermore, the formation of a large-area ordered structure of toric focal conic domains was generated. This work was done with C. R. Safinya's group at UCSB and Hee-Tae Jung's group at KAIST.

[1] M.C Choi at. al, Macromolecules 2005,38, 9882-9884
[2] M. C. Choi at. al, PNAS 2004, 101, 17340-17344
[3] D. K. Yoon at. al, Nature Materials, 2007, 6, 866-870