Orientation Control of Supramolecular Helical Nanostructures

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We have examined the controlled B4, helical nanofilament (HNF) phases under different boundary conditions including on the flat substrates treated with various kinds of self-assembled monolayers (SAMs) and in the micro- and nanoconfined geometries.[1-3] Here, we showed that the surface anchoring interaction strength induced form various SAMs could be used to control the orientations of the B2 smectic layers and the following B4 phase. These results suggest that a variety of surface treatment methods may be used to control complex HNFs over large areas. Surface anchoring effects governed the initial stages of the B2 layer growth by restricting growth within a few microns of the film during the thermal phase transition.[2] The achievement of an aligned B4 phase, which is notoriously difficult to orient using other methods, showed that the use of a variety of surface functional groups to control the molecular orientations may prove to be a powerful tool for the preparation of LC layers for use in applications that require hydrophobic surfaces.[3]

We also introduced a novel chiral nano-pore-system using bent-shaped liquid crystals (LCs) and porous anodic aluminum oxide (AAO) films to achieve functional 3-dimensional nanostructures.[4] Under this environment, individually grown HNFs were readily found in nanochannels of AAO film,[4] in which both of the helical pitch and width of HNFs were controlled by varying the sizes of AAO-diameters. Based on our experimental platform, we also showed that the molecular configuration and layer conformation of classical and modulated HNFs can be controlled using the physicochemical (size + chemical affinity) confinement.[5,6] Lastly, the photo-modulated supramolecular chirality in achiral photo-responsive rod-like molecules was studied to show the possibility of using this nanoconfinement system in optical applications.[7] All these results could be clearly understood using high resolution electron microscopy and grazing-incidence X-ray diffraction (GIXD) techniques.

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