Nanostructured Functional Liquid-Crystalline Assemblies

Takashi Kato

Department of Chemistry and Biotechnology
School of Engineering
The University of Tokyo,
Bunkyo-ku, Tokyo, 113-8656 Japan

[E-mail: kato@chiral.t.u-tokyo.ac.jp]

We have been developing new generation of liquid-crystalline (LC) materials and related functional soft materials[1]. LC materials exhibiting ionic, photonic, and electric functions as well as stimuli-responsive and sensing properties have been prepared based on the control of the formation of nanostructures. Control of phase-segregated structures and use of intermolecular interaction of hydrogen bonding and ionic interaction as well as π-π interaction are also important for the preparation of these materials. Nanostructured liquid crystals such as smectic, columnar, micellar cubic, and bicontinuous cubic phases are employed for such functionalization[2]. One of our approaches is to use these nanostructures of liquid crystals for the transportation of ions, charges, and molecules. Anisotropic, efficient, and selective transportation can be achieved by using 3D, 2D, and 1D channels in self-assembled structures. For example, 3D ionic channel networks have been obtained by self-assembly of ammomium and phosphonium ionic LC molecules. Stimuli-responsive liquid crystals that exhibit mechanically-induced luminescence changes have also been developed[3]. Once the mechanical shear force is applied to LC π-conjugated molecules having dendritic moieties, the emission color is changed due to mechano-induced phase transitions. Nanostructured LC materials transporting charge have been prepared by controlling self-assembled structures of π-conjugated molecules[4,5]. Liquid-crystalline physical gels have also been developed as functional ordered composites[6,7].

References

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