Multi-Scale Structural Characterization and Modulation of Self-Assembly Functional Materials

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The macroscopic peroformances of materials is the ultimate outcome of a cascade of structures that exist at different length scales. Developing the characterization tools to identify the structures at different length scales is thus important for the advancement of materials science. In this presenation, characteriztion tools for the multi-scale structural chaterization of two self-assembly functional materials will be introduced. In the first part, charaterization of the polymorphism,[1] low-angle grain boundary (LAGB),[2] and crystallinity[3] of the crystal arrays of conjugated molecules in the thin-film state will be demonstrated. The influences of these morphological factors to the charge mobility of a semiconducting molecule will also be discussed to demonstrate the importance role of unification the lattice orientation, packing structure, and the crystalline domain in the performances of the solution-processed organic field-effect transistors (OFETs). In the second part, a novel procedure called "water-induced self-assembly (WISA)" will be introduced. In WISA, water is used as an active substrate that regulate the self-assembly and function of an amphiphilic discotic molecule (**ADM**). Characterization results indicated that water fits into the hydrophilic core of the ADM and induce the formation of a hexagonal columnar phase (Col_h) that contains hydrated artificial water channels (AWCs). The hydrated AWCs are adaptive rather than static as the dynamic incorporation/removal of water resulted in the reversible assembly/disassembly of the adaptive AWCs (aAWCs). Furthermore, the dynamic characteristic enable water to act as the nucleation agent that controls the growth direction of the aAWCs. Well-aligned aAWC arrays that showed ability of water transport was obtained *via* our "directional WISA" method. By making water an active component in adaptive chemistry, and enable the dynamic interaction with water, this adaptive aquatic material may motivate the development of synthetic molecules further toward living matters.

References

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