SUPERMOLECULES AS SOFT MATERIALS WITH DYNAMIC STRUCTURES AND FUNCTIONS *IN ALL DIMENSIONS: FROM MOLECULES TO NANO, MICRO, AND BULK*

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Our group has developed new kinds of supramolecular materials whose dimensions are categorized in nano, micro, and bulk scales as summarized in Figure 1. Construction of nanostructures was demonstrated by formation of two-dimensional arrays of functional porphyrins in which molecular pattern shifting was observed by real-time STM observation (A).[1,2] Various mesoscopic morphologies were successfully constructed through self-assembled process from alkyl-substituted fullerene as a shape-shifter (B),[3] which can also provide nanoarray (C)[4] and bulk liquid material (D).[5] Structure transcription of molecular assembly provided well-structured bulk materials such as novel carbon materials "carbon nanocage",[6] which exhibits unique material separation properties (E).

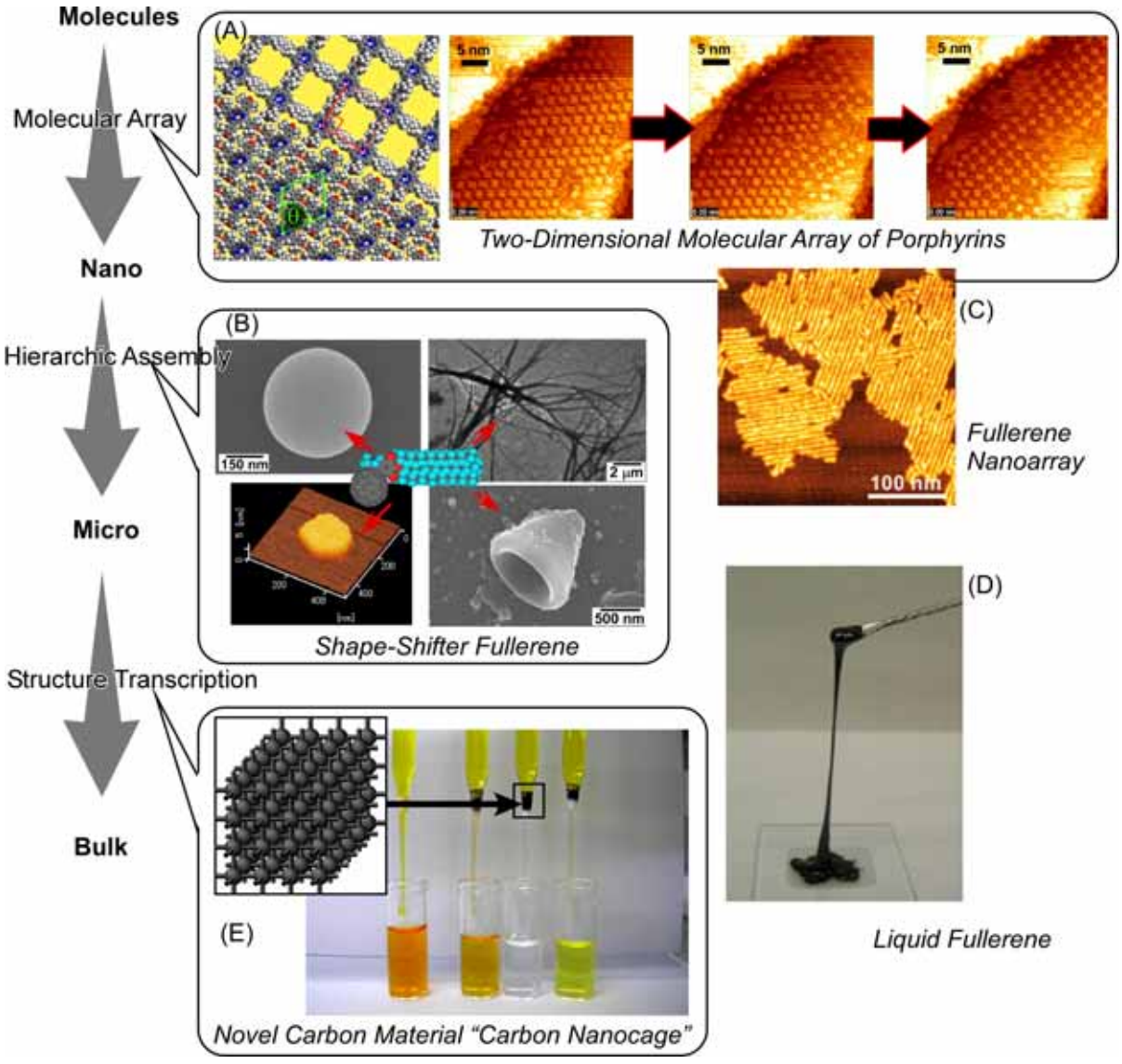

Figure 1. Various supramolecular materials developed in our research group.

In order to develop methodologies to bridge molecular and bulk dimensions, dynamic molecular recognition at the air-water interface has been investigated. Compression and expansion of a Langmuir monolayer of designed host in sub-meter dimension induces change of molecular conformations of the host, resulting in repeated capture and release of aqueous guests (A).[7,8] Upon extending this concept to molecularly twisted host monolayer, chiral recognition of aqueous amino acids can be controlled by applying bulk lateral pressure (B).[9] In these examples, stimuli at then bulk level induces molecular level functions.

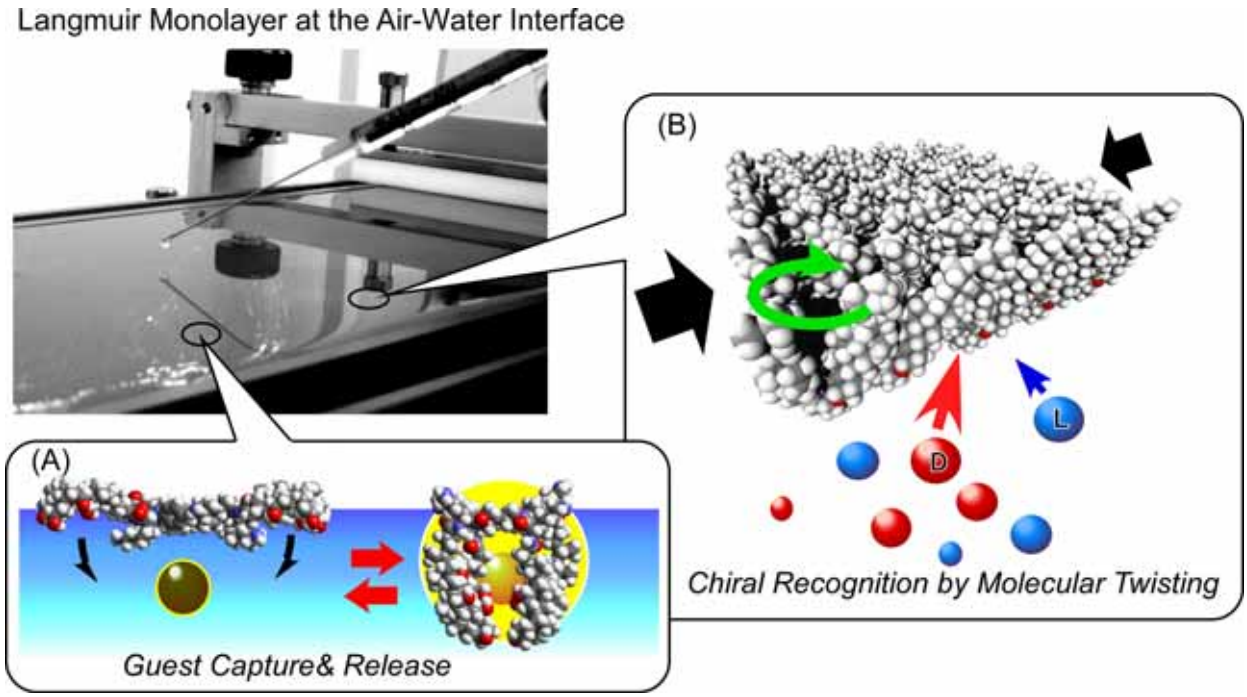

Figure 2. Dynamic molecular recognition for a method bridging molecular and bulk dimensions.

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