McGill Chemical Society

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Advanced Molecular Design of Functional Soft Materials

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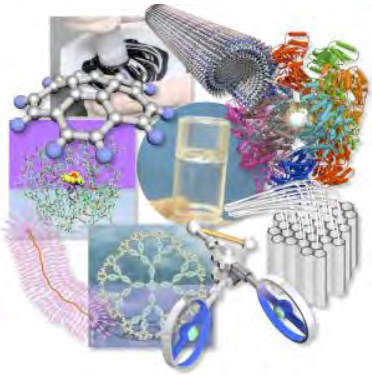
Otto Maass room 10

Owing to a tremendous progress in supramolecular chemistry, one can now construct and tailor a variety of desired nanostructures, where assembling events involved mostly operate thermodynamically. On the other hand, if one may consider developing materials for practical applications, we certainly need to design kinetically preferred hierarchical structures. However, there is no rational molecular design strategy for this issue. Here we report some of our recent achievements related to this issue. The first topic focuses on how one can translate a tiny molecular motion into a macroscopic motion.[1] We found that, by hot pressing using unidirectionally drawn Teflon sheets, a polymer brush containing triply connected azobenzene units in its side chains form a hierarchically ordered bimorph film, where all the cylindrical brush objects align homeotropically with respect to the film plane, and the film shows a macroscopic photomechanical motion. The second topic features the development of 'aqua material', characterized by an ultralow content of organic components and an ultrahigh content of water.[2] This material can be prepared by mixing in water clay nanosheets and a dendritic molecular binder with sticky guanidinium ion functionalized dendron wedges on both sides of a poly(ethylene glycol) spacer, giving rise to the formation of a well-developed 3D network over a macroscopic length scale. The third topic features our quite recent achievement on the formation of a linear semiconducting heterojunction by stepwise supramolecular polymerization.[3,4] This sequential control in supramolecular polymerization gives a clue for how to escape from a thermodynamic equilibrium. We also succeeded in designing the first columnar ferroelectric liquid crystal,[5] ATP-responsive bionanotube,[6] and a modular approach to complicated nanostructures.[7]



References:
[1] Wang et al., Nature 2010, 463, 339. [2] Hosono et al., Science 2010, 330, 808. [3] Wei et al., Science 2011, 334, 340. [4] Aida et al., Science 2012, 335, 813. [5] Miyajima et al., Science 2012, 336, 209. [6] Biswas et al., Nature Chem. 2013, 5, 613. [7] Fukino et al., Science 2014, 344, 499.