

Supramolecular Assembly toward Organic Nanostructures

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Controlled supramolecular organization of specific self-assembling molecules is a challenging topic of research in the fields of synthetic chemistry and materials science because it provides the spontaneous generation of well-defined nano-scale structures from molecular components under thermodynamic equilibrium. In rigid-flexible block molecular system, consisting of a flexible coil and a rigid rod, the anisotropic orientation of the rod segments and the repulsion between the covalently connected blocks lead to self-organization into a wide variety of aggregation structures. The careful selection of the type and relative length of the respective blocks can give rise to a variety of the well-defined supramolecular structures in nanometer-scale dimensions (Figure 1).

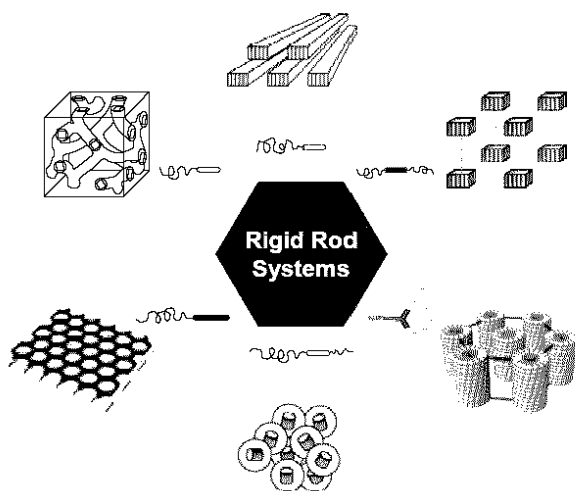


Figure 1. . Various supramolecular structures in bulk.

Another interesting feature of rigid-flexible block molecules is their amphiphilic characteristic that shows a strong tendency of their lipophilic and lipophobic segments to separate in space into distinct nanodomains. Depending on the solvent content and polarity, rigid-flexible block molecules self-assemble into different aggregated structures *via* mutual interactions between block segments and solvent. We have explored a strategy to control the supramolecular nanostructures self-assembled from rigid segments through attachment of flexible chains through microphase separation and anisotropic arrangement. Supramolecular structures formed by self-assembly of rigid building blocks can be precisely controlled from 1-D layered, 3-D bicontinuous cubic to 2-D cylindrical structures by systematic variation of the type and relative length of the respective blocks. Furthermore, depending on the individual molecular architectures, rigid building blocks self-assemble into a wide range of supramolecular structures such as honeycomb, disk, cylinder, helix, tube, barrel stave, and nano-cage (Figure 2).

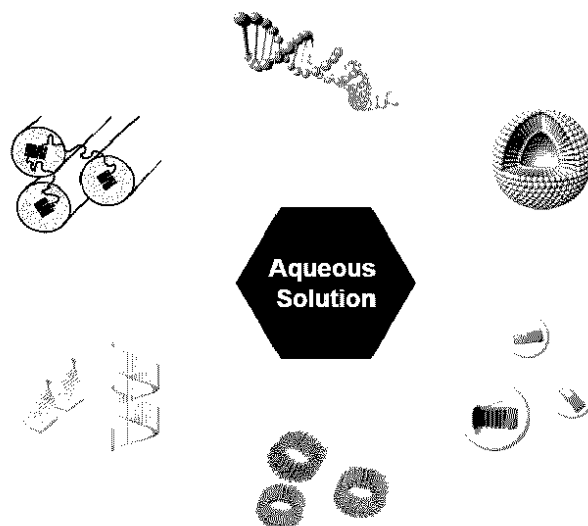


Figure 2. . Various supramolecular structures in solution.

The primary driving force responsible for the formation of these unique nanostructures is likely to be the combination of shape complementarity and microphase separation between rigid and flexible segments. The size and period of these supramolecular structures are typically in the range of 5 to 15 nm. These organic nano-assemblies have been proposed to have a number of application potentials such as nanocarrier, supramolecular reactor, target selective drug delivery and transmembrane ion channels.

Reference

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