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Beyond hierarchical order in biomimetic and liquid crystalline block copolymers

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Recent work in our group on hierarchical order in block copolymers containing polypeptide or liquid crystal groups has focussed on several aspects: (i) Nanostructure formation of PEG-containing block copolymers in the solid state, [1,2] (ii) Solution self-assembly of PEG-peptide containing biologically inspired peptide sequences based on coiled coil and "switch" peptide motifs, [3] (iii) Dynamic processes of rod-like micelles formed by polystyrene-poly(L-lysine) diblocks in aqueous solution, [4,5] (iv) Self-assembly of side group liquid crystal block copolymers.[6]

We will first review this work and then explore how we can go beyond this hierarchical ordering to prepare novel functionalized and responsive materials. Some examples of several new types of soft material exploiting the ordering of ABC triblock copolymers of various types are shown in the Figure.

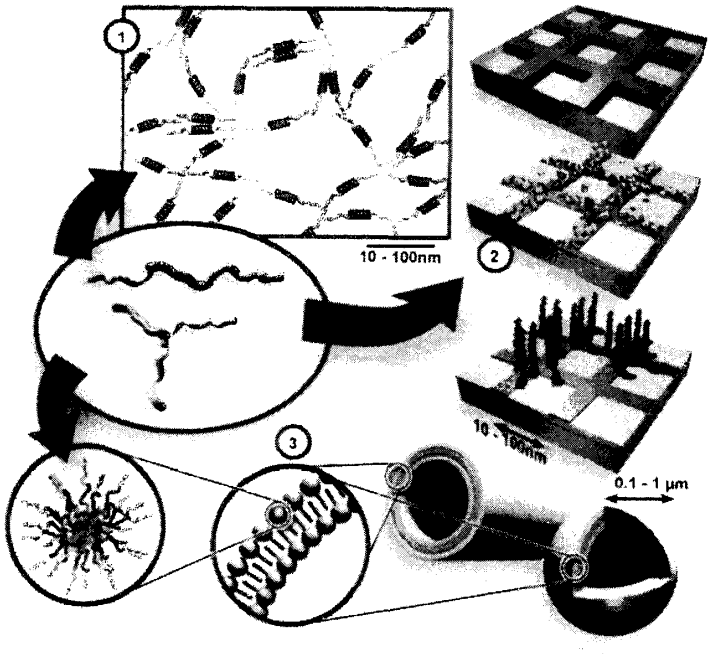

Figure. (1) Peptide copolymer nanostructures. An example shown in the schematic above shows a hydrogel formed by association of hydrophobic α-helical peptide midblocks within asymmetric triblock copolymers (comprised of PEG chains with different molar mass) is indicated., (2) Self-assembly of ABC triblock copolymers in thin films to form nanoarrays with applications in (top to bottom) nanolithographic etching of topographic features, nanoparticle deposition, tethered DNA array fabrication, (3) Self-assembly of giant block copolymer amphiphiles. The green "headgroup" of the amphiphile is a cross-linked block copolymer micelle or vesicle (formed itself from AB or ABC triblock copolymers), attached to a polymeric tail. These amphiphiles are expected to self-assemble into giant structures including nanotubes and vesicles.

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