

Bio-Inspired Building Blocks for Organic Nanotechnology

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Organic nanotechnology is clearly a new front in the field of molecular self-assembly of new structures and composite families at the nano-scale. Our works on the mechanism of aromatic peptide self-assembly, lead to the discovery that the diphenylalanine recognition motif self-assembles into peptide nanotubes with a remarkable persistence length. Other aromatic homodipeptides (including those with non-coded amino acids as DOPA) could self-assemble in nano-spheres, nano-plates, nano-fibrils and hydrogels with nano-scale order. The modification of peptide building blocks with the Fmoc protecting group allows the formation of hydrogels with nano-scale order. We demonstrated that the peptide nanostructures have unique chemical, physical and mechanical properties including ultra-rigidity as aramides, semi-conductive, piezoelectric and non-linear optic properties. We also demonstrated the ability to use these peptide nanostructures as casting mould for the fabrication of metallic nano-wires and coaxial nano-cables. The application of the nanostructures was demonstrated in various fields including electrochemical biosensors, tissue engineering, and molecular imaging. We had developed ways for depositing of the peptide nanostructures and their organization. We had use inkjet technology as well as vapour deposition methods to coat surface and from the peptide "nano-forests". We recently demonstrated that even a single phenylalanine amino-acid can form well-ordered fibrillar assemblies of distinct electron diffraction pattern and toxic properties. The combination of DNA properties and peptide backbone in the form of Peptide Nucleic Acid (PNA) resulted in light emitting assemblies that exhibit both stacking and Watson-Crick base-pairing.

Selected References

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