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EDITORIAL

Special Issue: Peptide Materials

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Anticipation is growing around the idea that peptide materials will underlie cutting-edge technologies that will facilitate human progress. There are currently several advantages to peptide materials. First, peptide materials are environmentally benign and renewable materials. Second, peptides are inherently adaptable to biosystems in various ways; applications for peptide materials are therefore rich in variety, ranging from biomaterials, drug delivery systems, tissue regeneration and biosensors to adhesives, coating agents, dielectric materials and molecular devices. By contrast, several drawbacks to peptides that have been frequently pointed out are that they are costly and lack long-lasting and heat-resistant properties. However, over time most of these drawbacks have been steadily overcome. For example, some amino-acid *N*-carboxyanhydrides, which are used for polypeptide synthesis, are now available as phosgene-free and recrystallization-free preparations. Once the appropriate amino acids are chosen, helical peptides retain their structure even at temperatures of more than 100 °C in air. Furthermore, unnatural amino acids widen the scope of functions covered by peptide materials. The Special Issue on Peptide Materials in *Polymer Journal* brings together a collection of distinctive reviews and articles that discuss peptide materials and their applications. Although we cannot cover all aspects of peptide materials in one special issue, we hope that this issue will act as a springboard to highlight to our readers the importance of peptide materials both now and in the near future.

In this Special Issue, Morelli *et al.* introduce the concept of theranostics, which are unified materials for diagnostic and therapeutic usages. Peptides decorate the surfaces of nanovectors that are localized to liposomes, naposomes, micelles, and polymeric micelles to endow them with targeting capabilities. Multimodality in function is a key issue in this field.

Kobatake and colleagues report on the use of hydrogel scaffolds for three-dimensional cell cultures. It is a wonder that peptides can be equipped with so many functions, such as self-assembly into hydrogels, cell-adhesive activity, angiogenesis, neural differentiation, and cell growth, all of which can be realized through the use of artificial extracellular matrices.

Higashi *et al.* successfully show the adsorption patterning of gold nanoparticles that are coated with thermo-responsive peptides. Elastin-like peptides are known to exhibit remarkably low critical solution temperatures. These types of peptides provide promising applications for obtaining stimuli-responsive materials.

Kimura and colleagues describe an extension to their previously reported patchwork molecular assembling technique to realize various complex morphologies. We anticipate that these specific morphologies will be useful for producing sophisticated materials in the future.

Matsuura and team show the potential application of peptide nanocages as DNA carriers. They demonstrate how peptides are effective in molecular assembly with a specifically designed structure, highlighting their structure-based function.

Mihara's group proposes a peptide photo-releasing array system to allow the realization of high-throughput cell arrays. Peptides, which the group immobilized on a plastic culture plate by a photo-cleavable linker, were tested efficiently and time dependently by photo-irradiation to elucidate their cellular toxicity. It is an imperative within this field to attain an efficient screening system for biologically active peptides and so the group is continuing to refine their system.

An article by Toniolo and colleagues highlights how our knowledge on peptides is still very limited through this report on the solubilization in water of hydrophobic Aib/Ala peptides through the formation of supramolecular assemblies. There may be many reasons to explain why peptides work so well in living systems, but few have so far been clarified.

In their contribution, Rosenman and colleagues describe a leading-edge technology to build peptide nanotubes onto SiO_2 substrates using a vapor deposition technique. Water is an essential component of the technique for obtaining vertically aligned nanotubes. This system is under investigation for its potential applications, including as nanopiezoelectric devices.

Gatto and Venanzi describe the formation of multicomponent peptide-based self-assembled monolayers functionalized with electro- or photoactive groups. The C^{α}-tetrasubstituted residues contributed to the stabilization of the helical conformation in the short peptides studied. Their results pave the way for the design of new bioinspired materials for nanoelectronic and optoelectronic devices.

Mother Nature has adopted peptides and proteins as functional materials in living systems. The bases of these functional materials are sure to be complex and we are only now beginning to understand the processes involved through the investigation of peptide materials. We would like to highlight to our readership the following two upcoming events of interest related to recent intensive research activities in the peptide materials field: (1) the prospective publication of a book entitled 'Peptide Materials: From Nanostructures to Applications' (Eds. A. Bianco, C. Aleman and M. Venanzi) from Wiley, which is due this Spring and (2) a conference on 'Peptide Materials for Biomedicine and Nanotechnology' that will be held in Sorrento, Italy, at the end of October 2013. We hope that this Special Issue on Peptide Materials will pique the interest of and promote further discussion among our readership.

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