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Supramolecular chemistry: A powerful tool to elaborate colorful multi-stimuli responsive macromolecular materials

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There is no doubt that the creation of high performance polymeric materials relies directly on our ability to manipulate these smart materials in a controllable, predictable and orchestrated fashion from nano to macro-scale. Recently, architectures where the individual polymer blocks are connected through supramolecular interactions such as hydrogen bonding, metal-ligand and pseudorotaxane like interactions have received significant attention. The inherent features of the molecular recognition-driven self-assembly confer significant advantages over their covalently linked brethren in terms of facilitating modularity and self-healing properties. Moreover, through careful design smart polymeric systems have been developed with stimuli-responsive structures and properties. Here, we report the successful engineering of new multi-stimuli responsive and colored macromolecular assemblies based on well-defined functionalized polymer building blocks incorporating both electro-deficient ($CBPQT^{4+}$) and electron-rich units (tetrathiafulvalene, naphthalene) moieties. The architectures of these materials have been constructed by specifically holding together complementary well-defined polymer building blocks (prepared by Controlled Radical Polymerization) with specially designed host/guest motifs attached in specific locations on polymer backbones. The inherent reversibility of supramolecular architectures has allowed on demand modular and tunable modification of structures and properties of materials. More particularly, we have exploited the presence of colored $CBPQT^{4+}$ based interactions to create smart micelles and hydrogels and reprogrammable supramolecular temperature and pH sensors with memory function. An important practical aspect of these new functional materials is that all relevant phenomena (self-assembly and disassembly processes, reading/reprogramming of temperature, memory function) have an associated visible readout, thereby affording convenient and quantifiable systems with applications spanning the physical and biological sciences.

Biography

Patrice Woisel has obtained his PhD in Organic Chemistry at the University of Lille, France in 1996 and was appointed as a Lecturer at the University of Dunkerque, France. In 2007, he became a Professor at the National School of Engineering Chemistry (ENSCL), France. He currently leads a research group of around 10 people and has written over 90 publications in major international journals.

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