New Frontiers in Supramolecular Design of Materials

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The powerful functions of materials in the living world utilize supramolecular systems in which molecules self-assemble through noncovalent connections programmed by their structures. Yet, the design of highly specific interactions between molecules began in earnest only three decades ago motivated by the Nobel Prize in Chemistry in 1987. Our laboratory has focused over the past three decades on integrating this notion of bio-inspired supramolecular engineering into the design of novel materials. I will discuss in my lecture three examples of functional supramolecular materials we need for our future. The first is inspired by the photosynthetic machinery of green plants, creating materials that harvest light to produce fuels for sustainable energy systems. The second example is that of life-like robotic materials that effectively transduce different types of energy into mechanical actuation and locomotion of objects for future technologies. The third topic will be supramolecular biomaterials that mimic extracellular matrices and provide unprecedented bioactivity to regenerate tissues. In this example, I will discuss a recent breakthrough in structural design of supramolecular motion which surprisingly led to biomaterials with potential to reverse paralysis by repairing the brain and the spinal cord.