Materials Designed to Mimic and Signal Biological Systems

Samuel I. Stupp

Departments of Materials Science and Engineering, Chemistry, Medicine, and Biomedical Engineering
Simpson Querrey Institute for BioNanotechnology
Center for Bio-Inspired Energy Science
s-stupp@northwestern.edu
https://stupp.northwestern.edu/

Molecular design of soft matter with the capacity to emulate behaviors of living creatures or ability to signal and change living systems is a major challenge in materials science. Given the dynamic behavior of living systems, the design has to cover "time" as the fourth dimension and go beyond 3D structure across scales. In our laboratory we focus on *supramolecular materials* designed with secondary bonds, which offer potential to create hierarchical structures and also tune dynamics at different scales given the broad energy range of intermolecular bonds. Two goals have been to create materials that imitate movement of living creatures and also bioactive materials for regeneration of tissues. Using supramolecular biomolecular and synthetic structures as well as covalent polymers in some cases we have developed objects that can rapidly bend and translate in response to light. In regeneration a broad platform of materials based on 3D filamentous networks has emerged with unprecedented ability to signal cells. The lecture will describe a recent breakthrough related to dynamic behavior of biomaterials, identifying supramolecular motion as an important feature in their ability to signal cells for regeneration in the spinal cord thus reversing paralysis and also in joint cartilage.

Short Biography

Samuel Stupp's interdisciplinary research is focused on developing self-assembling supramolecular nanostructures and materials for functions relevant to renewable energy, regenerative medicine, and robotic soft matter. He is a member of the U.S. National Academy of Sciences, the U.S. National Academy of Engineering, the American Academy of Arts and Sciences, the Royal Spanish Academy, the National Academy of Sciences of Latin America, the National Academy of Sciences of Costa Rica, and the U.S. National Academy of Inventors. Stupp has won numerous awards over the course of his career, including three American Chemical Society national awards: the Award in Polymer Chemistry, the Ronald Breslow Award for Achievement in Biomimetic Chemistry, and the Ralph F. Hirschmann Award in Peptide Chemistry. He recently received the 2022 Materials Research Society Von Hippel Award, the highest honor awarded by this society. Other awards include the Department of Energy Prize for Outstanding Scientific Accomplishment in Materials Chemistry, the Materials Research Society Medal Award, the Royal Society of Chemistry Award in Soft Matter and Biophysical Chemistry, and the Nanoscience Prize from the International Society for Nanoscale Science, Computation, and Engineering, which recognizes lifelong achievement in the field.