BIO-INSPIRED POLYMER CHEMISTRY

Roeland J.M. Nolte

Radboud University Nijmegen, Institute for Molecules and Materials, Heyendaalseweg 135, 6525 AJ Nijmegen, The Netherlands, e-mail R.Nolte@science.ru.nl

ABSTRACT

Christiaan Huygens (1629–1695) is a famous Dutch scientist whose inventions and discoveries changed 17th century science. He used as a motto: Experientia ac Ratione (with experience and reason). This is the approach to science that we also follow in our scientific endeavors. There is, however, another aspect that has helped us to find our way: inspiration, in particular by Nature.

In this lecture I will present examples of bio-inspired research situated at the interface of macromolecular chemistry and supramolecular chemistry including some of the following topics: (*i*) the design and synthesis of self-assembled nanostructures from isocyanopeptidic homopolymers and amphiphilic block copolymers.The formed architectures can form biomimetic cytoskeletons and act as nanoreactors that can be taken up by cells and function as artificial organelles. *(ii)* The synthesis of polymersome nanostructures that can undergo shape transformations to give synthetic stomatocytes, which are small nano-sized containers with an opening of controllable size. In the cavity of these containers a cargo can be entrapped, e.g. enzymes or catalytically active platinum particles. Using the latter cargo a nanomotor system was developed and the movement of this motor was followed by nanoparticle tracking analysis. *(iii)* The synthesis of polymer-protein hybrids, which on dispersal in water form different types of nano-sized assemblies, e.g. toroids, Y-shaped architectures, and cell-like objects in which cascade reactions can take place. *(iv)* The synthesis of biohybrid architectures from viruses, including the Cowpea Chlorotic Mottle Virus (CCMV) and the Potato Virus X. The genetic material of the CCMV particles has been removed and replaced by enzyme molecules to create a nanoreactor and by polymers and inorganic components to generate functional biohybrid architectures. These virus-like particles (VLP's) have been combined with photocleavable dendritic polymers to give photoswitchable colloidal systems.