Biology-Inspired Materials

H.-A. Klok, I. Schnell

Polypeptides can adopt well-defined secondary structures and self-assemble into hierarchically organized superstructures. Most synthetic polymers, in contrast, are amorphous or semi-crystalline materials, which are characterized by a relatively low degree of structural order. In this project, the conjugation of peptide sequences to synthetic polymers is explored as a means to improve control over the nanoscale supramolecular organization of synthetic polymers. If the self-assembly properties of peptide sequences are retained upon conjugation to a synthetic macromolecule, then this strategy may allow the development of novel macromolecular materials with unprecedented levels of structural control.

The work in this project can be divided in three major areas: (i) The design and synthesis of novel polypeptide (hybrid) materials. Synthetic strategies that are used for the preparation of the materials include both the ring-opening polymerization of α-amino acid N-carboxyanhydrides as well as solid-phase techniques. (ii) The development of analytical techniques for the molecular characterization of peptides and other biomolecules. In particular, efforts are made to develop NMR methods that allow improved on-bead investigation of peptides and saccharides. To determine their molecular structure and dynamics, techniques and strategies from solid-state NMR have been introduced into the so-called high-resolution MAS (HRMAS) approach. (iii) The characterization of the supramolecular organization and nanoscale structure of the peptide materials, both in solution and in the solid state. For this purpose, a wide range of scattering and microscopy techniques is used. An important question is the correlation between the secondary structure of the peptide chains and the supramolecular organization of the materials. The secondary structure of the peptide materials is probed, amongst others, in complementary infrared, circular dichroism and solid-state NMR experiments.

REFERENCES: