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Self-Healing Polymer Networks

FRANCOIS TOURNILHAC, Ecole Superieure de Physique et Chimie Industrielles (Paris)

Supramolecular chemistry teaches us to control non-covalent interactions between organic molecules, particularly through the use of optimized building blocks able to establish several hydrogen bonds in parallel. This discipline has emerged as a powerful tool in the design of new materials through the concept of supramolecular polymers. One of the fascinating aspects of such materials is the possibility of controlling the structure, adding functionalities, adjusting the macroscopic properties of and taking profit of the non-trivial dynamics associated to the reversibility of H-bond links. Applications of these compounds may include adhesives, coatings, rheology additives, high performance materials, etc. However, the synthesis of such polymers at the industrial scale still remains a challenge. Our first ambition is to design supramolecular polymers with original properties, the second ambition is to devise simple and environmentally friendly methods for their industrial production. In our endeavours to create novel supramolecular networks with rubbery elasticity, self-healing ability and as little as possible creep, the strategy to prolongate the relaxation time and in the same time, keep the system flexible was to synthesize rather than a single molecule, an assembly of randomly branched H-bonding oligomers. We propose a strategy to obtain through a facile one-pot synthesis a large variety of supramolecular materials that can behave as differently as associating low-viscosity liquids, semi-crystalline or amorphous thermoplastics, viscoelastic melts or self-healing rubbers.