POTENTIAL OF METALLOSUPRAMOLECULAR POLYMERS FOR SELF-HEALING MATERIALS AND OVERVIEW ABOUT THE GERMAN PRIORITY PROGRAMME "DESIGN AND GENERIC PRINCIPLES OF SELF-HEALING MATERIALS"

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Keywords: Self-healing materials, Self-healing polymers, Metallopolymers, Priority programme

ABSTRACT

Supramolecular polymers feature a high potential for self-healing materials due to the reversibility of their supramolecular bonds. The reversible nature of these bonds can be utilized to open bonds and to close these bonds after the self-healing. Several kinds of these bonds have been investigated in the context of self-healing materials: hydrogen bonds, ionic interactions, and π-π-interactions. Hydrogen bonds were utilized in a self-healing rubber, an oligomeric, thermoplastic elastomer (fatty acids and diethylene diamine, which are subsequently functionalized with urea).[1] Ionic interactions contribute to the self-healing ability of commercial ionomers (*e.g.*, Surlyn, Nucrel) after ballistic impact.[2]
Furthermore, π-π-interactions were used for the self-healing of a siloxane based polymer.[3] In contrast, examples of self-healing polymers based on metal-ligand interactions are very scarce, although metallosupramolecular polymers are well-known for the incorporation of reversible metal complexes (with the right combination of metal ion and ligand).[4] These polymers were also applied in the context of stimuli-responsive materials.[5] The reversibility and the possible stimuli-responsiveness makes these polymers to interesting candidates for self-healing materials, which was recently demonstrated for optically healable polymers.[6]
The potential, but also the current limitations, for self-healing based reversible metal-ligand interactions in polymers will be discussed in general.[4,7] Furthermore, selected examples of metallosupramolecular polymers, based on terpyridine ligands, will be presented. Their reversible behavior (Figure 1) will be presented and their application in self-healing systems will be discussed.

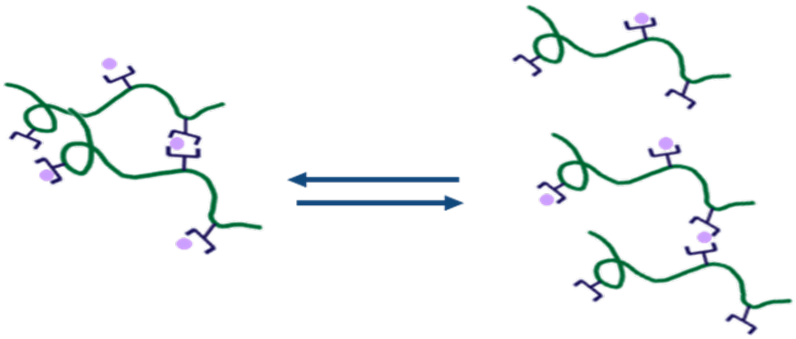

Figure 1: Schematic representation of the reversible binding and opening of metallo polymers.

Furthermore, a short overview about the German Priority Programme "Design and Generic Principles of Self-healing Materials" (SPP 1568, established by the Deutsche Forschungsgemeinschaft - German Research Foundation) will be given.[8] This programme combines research on self-healing materials over a wide range of material classes, *i.e.* polymers and polymer composites, metals, ceramics as well as concrete. The main objective is to elucidate fundamental cross-disciplinary, material-independent

principles and design strategies and to apply the knowledge gained to new approaches in the different material classes. The ultimate goal is to provide a new generation of adaptive high-performance materials that can be used for various applications in technology and medicine. The programme committee consists of Ulrich S. Schubert (Coordinator, Friedrich-Schiller-University Jena), Peter Greil (Friedrich-Alexander-University Erlangen-Nürnberg), Christoph Leyens (Technical University Dresden), Sybrand van der Zwaag (Delft University of Technology).

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