Polymers under Multiple Constraints

Polymer- & Soft-Matter-Seminar

Tuesday, 23rd October 2018

at: **5.15pm**

VDP4 1.27, Von-Danckel-mann-Platz 4, 06120 Halle

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"Responsive Materials Based on Non-Covalent Interactions"

Supramolecular polymers are furnished by the assembly of monomeric units equipped with binding motifs that form directional, non-covalent interactions such as hydrogen bonds, π-interactions, or metal-ligand coordination complexes.[1] Exposure of the bulk polymers to external stimuli such as heat, light, mechanical force, or certain chemicals disrupts the reversible and dynamic linkages, leading to a disassembly into the monomers and pronounced changes of the materials properties.[2] This renders supramolecular polymers uniquely suited for the development of tailored materials that display defined changes in their color, fluorescence, or mechanical properties in response to specific stimuli.[3,4]

Figure 1. The assembly of monomers that carry suitable non-covalent interactions gives rise to supramolecular polymers. The reversible and dynamic linkage in such materials directly translates into stimuli-responsive properties in the bulk.

In this presentation, recent examples will be discussed that use hydrogen-bonding, π-interactions, as well as metal-ligand coordination complexes for the preparation of polymers and composite materials that display useful stimuli-responsive properties. In particular, we have employed excimer forming dyes and exerted control over their aggregation as a means to prepare materials that show a visually detectable fluorescence color change upon application of mechanical force as a stimulus.[5,6] Such materials are of great interest for many applications, including structural health monitoring and tamper-proof packaging. Moreover, recent investigations that focus on the use of metal-ligand coordination complexes to access supramolecular polymer materials with new functions and tailored properties will be discussed. In particular, the preparation of polymer coatings that show defined responses to chemical stimuli, the development of polymer materials with tunable mechanical properties, and insights into the molecular requirements for an efficient welding or healing of such polymer films will be emphasized.

References:

(1) Yang, L.; Tan, X.; Wang, Z.; Zhang, X. *Chem. Rev.* **2015**, *115*, 7196–7239.
(2) Minko, S. *et al. Nat. Mater.* **2010**, *9*, 101–113.
(3) Herbert, K. M.; Schrettl, S.; Rowan, S. J.; Weder, C. *Macromolecules* **2017**, *50*, 8845–8870.
(4) Calvino, C.; Neumann, L.; Weder, C.; Schrettl, S. *J. Polym. Sci. Part A* **2017**, *55*, 640–652.
(5) Lavrenova, A.; Balkenende, D. W. R.; Sagara, Y.; Schrettl, S.; Simon, Y. C.; Weder, C. *J. Am. Chem. Soc.* **2017**, *139*, 4302–4305.
(6) Calvino, C.; Guha, A.; Weder, C.; Schrettl, S. *Adv. Mater.* **2018**, *4*, 1704603.