CENTER FOR RESEARCH IN SOFT MATTER & POLYMERS

CRiSP SEMINAR

MONDAY, NOV. 4, 2019

10:00 A.M.

366 COLBURN LAB

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Dr. Schrettl is a Group Leader at the Adolphe Merkle Institute (AMI) of the University of Fribourg. Dr. Schrettl studied Chemistry at Freie Universität Berlin and ETH Zurich, and then received a PhD in Materials Science from Ecole Polytechnique Fédérale de Lausanne (EPFL) in 2014, working on wet-chemical approaches toward carbon nanostructures with Prof. Holger Frauenrath. This was followed by postdoctoral research first at EPFL and then with Prof. Christoph Weder at the AMI.

His work focuses on addressing both fundamental and application-oriented challenges in materials science by a chemistry-driven approach. His research interests particularly include investigations into the structure-property relationship of supramolecular polymers, the development of bio-inspired materials based on non-covalent interactions, as well as the preparation of polymers and composites that respond in a useful and defined manner to external stimuli.

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"Tunable and Responsive Supramolecular Polymer Materials"

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] Stimuli such as heat, light, mechanical force, or certain chemicals disrupt the reversible and dynamic linkage, leading to a (temporary) disassembly into the monomers and pronounced changes of the materials properties.[2] This renders supramolecular polymers uniquely suited for the development of materials with useful functions such as healing, chromism, changes in shape, or reversible adhesion.[3,4] However, on account of the low glass transition temperature (Tg) of the typically employed building blocks, most supramolecular polymers display mechanical properties comparable to elastomers.

In this presentation, we report how metallosupramolecular polymers with mechanical properties comparable to those of commodity plastics can be obtained by blending a semicrystalline component with a rubbery one.[5] Both components feature the same metal-ligand complexes, which leads to a co-assembly into uniform blends. The mechanical properties of these materials are readily adjusted by varying the ratio of the two constituents. Some of the blends display a strength, toughness, or failure strain that substantially exceeds the one observed for either metallosupramolecular polymer alone, thereby granting access to mechanical properties that so far remained difficult to access with supramolecular materials.

Moreover, this contribution will also discuss the preparation of metallosupramolecular polymers based on zero-valent metal-

ligand complexes as well as their use as a precursor for the in-situ and space-resolved preparation of nanocomposites consisting of metallic nanoparticles and polymers.[6] The latter combine the functional, structural, and mechanical properties of the two components and are useful for applications that range from catalysis to soft electronics.

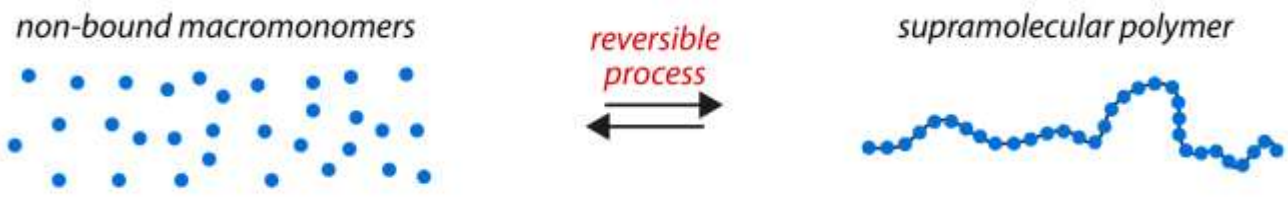

Figure 1. The assembly of monomers that carry suitable non-covalent interactions gives rise to supramolecular polymers. The reversible and dynamic linkage in such materials directly translates into stimuli-responsive properties in the bulk.

References:

(1) Yang, L.; Tan, X.; Wang, Z.; Zhang, X. *Chem. Rev.* 2015, *115*, 7196.
(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) Sautaux, J.; Marx, F.; Gunkel, I.; Weder, C.; Schrettl, S. *Submitted*.
(6) Olaechea L. M.; Montero de Espinosa, L.; Oveisi, E.; Balog, S.; Sutton, P.; Weder, C.; Schrettl, S. *Submitted*.