TOWARDS HIGH PERFORMANCE SUPRAMOLECULAR MATERIALS

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Abstract

Thermosetting materials consist of covalently cross-linked macromolecular chains with high temperature and chemical resistance, as well as good mechanical properties. However, these materials cannot be reprocessed and recycled as they directly degrade at high temperatures. On the other hand, thermoplastics show melt processability and a broad range of properties in the solid state, depending on their composition, but the high melt viscosity of many engineering thermoplastics such as polyamides often limits their applications. Supramolecular polymers are a promising alternative to overcome these disadvantages, as their monomeric units are linked by non-covalent bonds that undergo reversible dissociation at high temperatures.[1] As a result, supramolecular polymers form very low viscosity, reprocessable melts as opposed to high molecular weight thermoplastics, which suffer from extensive entanglement. Therefore, to some extent, it should be possible to prepare new supramolecular polymers with similar properties to thermoplastic and thermosetting materials, but enhanced processability and recyclability, in addition to stimuli-responsiveness, as non-covalent bonds are more susceptible to small changes or external stimuli such as temperature or UV-light.[2]

Previous work in our group focused on the synthesis and characterization of Bisphenol A-co-epichlorohydrin-based supramolecular networks displaying hydrogen bonding interactions between carboxylic acid and pyridine groups.[3] These materials presented high stiffness and low melt viscosity, but were also brittle. In this contribution, we will present different strategies used to render these materials tougher, including the use of a plasticizing supramolecular chain stopper, and the introduction of low-glass-transition 4-vinylpyridine/acrylate copolymers to induce the formation of soft nanodomains and stop crack propagation (Fig. 1).

References

[1] Yang, L.; Tan, X.; Wang, Z.; Zhang, X. *Chemical Reviews*, **2015**, 115, 7196-7239.

[2] Montero de Espinosa, L.; Fiore, G. L.; Weder, C.; Johan Foster, E; Simon, Y. C. *Prog. Polym. Sci.* **2015**, 49, 60-78.

[3] Balkenende, D. W.R.; Olson, R. A.; Balog, S.; Weder, C.; Montero de Espinosa, L. *Submitted.*

Figure

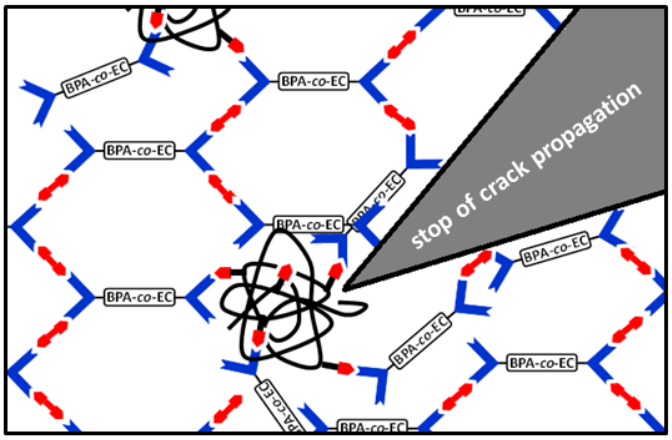

Fig.1: Proposed approach to stop crack propagation in high-T_g supramolecular networks.