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Editorial

Self-healing polymers

Overcoming destruction and degradation of polymeric materials not only represents a basic human desire, but also a significant contribution towards life-cycle improvement and safety-improvement of materials. With the advent of self-healing (SH) materials not only a new vision of material science had been accomplished, but also the exploitation of highly sophisticated chemical and physical principles had entered the field of commodity polymers [1].

The current issue in "Polymer" [2–20] provides insight into the new developments of SH-polymers and materials, written by an international panel of experts in the field focused on chemical and physical concepts for self-healing polymers. Thus a large number of different research- and development-fields of polymer- and materials science have been rejuvenated, as the design of self-healing polymers requires a multidisciplinary approach: e.g. network dynamics [2,3,7,15] and nanoparticle systems [12] have been studied to allow sufficient fast crosslinking and thus crack-repair after mechanochemical damage with an optimization of chemical and physical principles [15].

The optimization of reversible supramolecular [21] (hydrogen-bonding [3,7], metal-ligand [8], pi/pi-stacking [10], ionomeric [11] or biomimetic [6]) and thermally reversible covalent bonding systems [13,18] as a responsive concept towards stress have been realized and form the basis for a stress-dependent reactivity; catalytic systems [14] have been investigated in terms of catalyst stability under the true conditions that self-healing materials require [14,16]. Chemically weak bonds can now be used to tune the conditions under which SH is taking place, including all stimuli-driven systems [8,11].

Thus most of all the time-scale required to restore the initial materials properties [2], the required temperature at which SH takes place together with the initial materials properties can be adjusted, enabling the realization of eg. dual healing systems [7,17] and even self-healing nanocomposites [7,18,19]. This in turn has allowed to generate a multitude of polymers with SH properties, among them rubbers- and thermoplasts [4,5,7], thermosets [9,14], coatings [13,20], thermal- [13] and light- [20] driven repair-systems, all exploiting different principles regenerating even better properties of the polymer matrix.

We do hope that this special issue provides an entry for many new readers, together with a stimulating excitement for the already specialized and "expert"-reader, inducing new technological interest and motivation for further materials development.

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