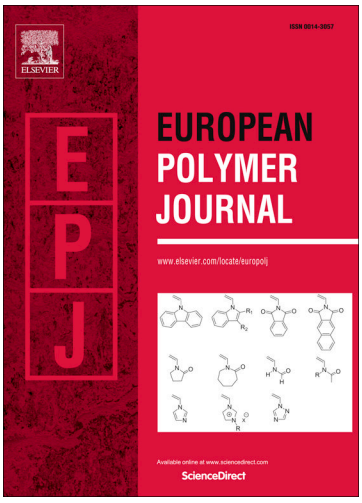

Design of a self-healing cross-linked polyurea with dynamic cross-links based on disulfide bonds and hydrogen bonding

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Abstract

In this work, diamine chain extenders containing disulfide bonds are reacted with triisocyanates to yield dynamic chemical cross-links based on exchangable disulfide bonds. The polyurea system with dynamic bonding shows drastic decline of storage modulus and very short relaxation times above 150 °C so that this polymer exhibits typical dynamic properties, *e.g.* self-healing, recycling and hysteresis loop recovery. The introduction of disulfide bonds dominates the thermal stimulated dynamic properties, since the control samples without disulfide bonds have longer relaxation times even at high temperatures. Interestingly, presence of disulfide bonds leads to the decline of hydrogen bonding strength which can result in their easier dissociation and subsequently easier topological network rearrangement. In addition, almost complete reversibility of the hydrogen bonding is observed from temperature-dependent Fourier Transform Infrared Spectroscopy, which reveals the important influence of hydrogen bonding on dynamic properties. Thus, Hydrogen bonding dissociation is an indirect reason of dynamic properties, while exchange reaction of disulfide bonds is the primary cause. The results may deepen our understanding of the role of hydrogen bonding in the dynamic materials. In addition, the available commercial raw component, operational feasibility and simplicity constitute a great advantage of the so-prepared dynamic polyurea system, *i.e.* an effective step to implementation of industrial applications and recycle the nonbiodegradable crosslinked polyureas.
Key words: disulfide bonds, hydrogen bonding, polyureas