Light-triggered transient self-adhesion in low-hysteresis hydrogels

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Abstract

Self-healing soft materials typically employ reversible molecular interactions such as dynamic covalent bonds or electrostatic interactions that also lead to energy dissipation during mechanical deformation. In this work, we demonstrate low-hysteresis, chemically crosslinked hydrogels with light-triggered strong self-adhesion, with time-dependent adhesion strength controlled by the duration of irradiation. Low hysteresis is achieved by swelling of the loosely crosslinked poly(*N*-isopropylacrylamide) hydrogel network. Rapid self-adhesion is enabled by localized photothermal heating of embedded gold nanoparticles that causes phase transition of the network, resulting in physical entanglement of collapsed polymer chains at the contact interface. The entangled interface provides nearly 100% recovery of the original mechanical properties, which undergoes gradual rehydration and disentanglement, leading to a decrease of adhesive strength to almost zero within a couple of hours. Notably, the self-adhesion mechanism can be combined with self-healing clay mechanism to achieve fast and strong recovery of interfacial strength between two pieces of hydrogels, providing new possibilities in accelerating self-healing process. The proposed self-adhesion mechanism with facile, efficient, and light-controlled temporal profile can be applied to various fields like soft robotics, biomedical applications, and flexible electronics.

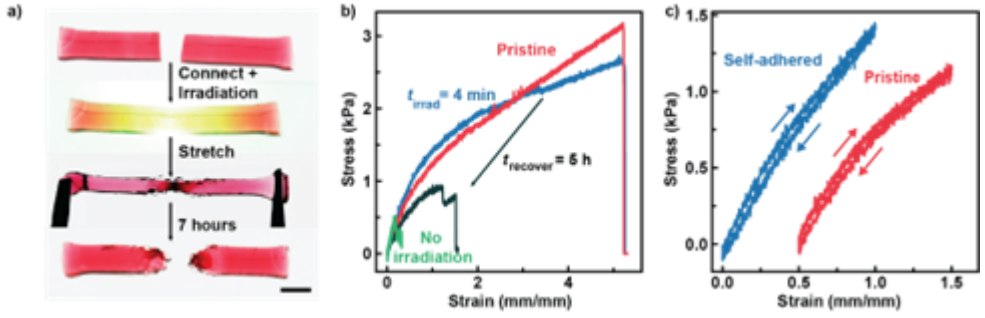

Figure 1: The self-adhesion process. a) a demonstration, scale bar 6mm. b) tensile test of pristine and adhered sample. c) low hysteresis in pristine and self-adhered sample.

References

[1] J. Yang, R. Bai, B. Chen, Z. Suo, *Adv. Funct. Mater.*, **30**, 1901693, (2020).

[2] H. Qin, T. Zhang, H. N. Li, H. P. Cong, M. Antonietti, S. H. Yu, *Chem*,**3**, 691,(2017).

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