

Self-Healable and Humidity-Resistant Polymer Glasses: New Strategies Based on Nano-Phase Separation

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Keywords: Self-Healing Material; Polymer Blend; Nano-Phase Separation

Self-healable polymers are expected to be game-changing materials that can solve environmental problems caused by plastic waste. In 2018, we reported poly(ether thiourea) that is mechanically robust yet readily repairable without heating and melting.¹ Later, other groups reported several related studies.² We recently reported a humidity-tolerant version of self-healable polymer glass using dicyclohexylmethane units.³ Our next step is to confer a self-healing property on non-healable polymers by simple blending. If such a strategy is possible, the development of self-healing polymers should be much more accelerated.

Here we report that a non-healable polymer turned to be self-healable at ambient temperatures by blending only a small amount of self-healable poly(ether thiourea). Interestingly, the resultant polymer blend nearly maintained the intrinsic properties of the non-healable polymer such as mechanical and hydrophobic natures. Detailed investigations using solid-state NMR spectroscopy revealed that a nano-phase separated structure was crucial to provide the non-healable polymer with the self-healing properties.⁴



1) Y. Yanagisawa, Y. Nan, K. Okuro, T. Aida, *Science* **2018**, 359, 72.

2) a) H. Wang, H. Liu, Z. Cao, W. Li, X. Huang, Y. Zhu, F. Ling, H. Xu, Q. Wu, Y. Peng, B. Yang, R. Zhang, O. Kessler, G. Huang, J. Wu, *Proc. Natl. Acad. Sci. U. S. A.* **2020**, 117, 11299. b) J. Xu, J. Chen, Y. Zhang, T. Liu, J. Fu, *Angew. Chem. Int. Ed.* **2021**, 60, 7947.

3) Y. Fujisawa, A. Asano, Y. Itoh, T. Aida, *J. Am. Chem. Soc.* **2021**, 143, 15279.

4) Y. Nan, Y. Fujisawa, A. Asano, Y. Yanagisawa, K. Yano, Y. Itoh, T. Aida, submitted.