Supporting information for

A stretchable and healable elastomer with shape memory capability based on multiple hydrogen bonds

Jiacheng Ma,[a] Shifeng Wen* [a] and Zhufeng Yue [a]

Table S1 The information of molar ratios and GPC results of HM-PUs

Sample	HMDI (g)	PTMEG (g)	IPDA (g)	DBTDL (g)	Hard segment (%)	M_n (g mol^{-1})	M_w (g mol^{-1})	PDI
HM-PU1	1.09	2	0.8	0.02	48.6	1.8×10^4	5.1×10^4	2.8
HM-PU2	0.81	2	0.51	0.02	39.8	2.4×10^4	6.3×10^4	2.6
HM-PU3	0.65	2	0.34	0.02	33.1	2.6×10^4	4.8×10^4	1.8

Table S2 The assignment of FTIR subpeaks in the C=O bands

Wavenumber (cm^{-1})	Assignment
1718	Free υ(C=O) urethane amide
1799	Ordered H-bonds υ(C=O) urethane amide
1654	Disordered H-bonds υ(C=O) urethane amide
1628	Ordered H-bonds υ(C=O) urea amide

Table S3 The mechanical properties of HM-PUs

Sample	Tensile strength (MPa)	Elongation (%)	Toughness (MJ m^{-3})	Young's modulus (MPa)
HM-PU1	37.6±2.4	663.3±21.7	98.5±12	57.5±11
HM-PU2	26.2±1.59	807.75±53.4	81.05±5.5	12.6±1.6
HM-PU3	21.3±0.4	1050.5±19.1	76.5±3.5	7.1±0.6

[a] *School of Mechanics and Civil & Architecture, Northwestern Polytechnical University, Xi'an 710129, RP China.*

** Corresponding author: E-mail addresses: wenshifeng@nwpu.edu.cn (Shifeng Wen)*

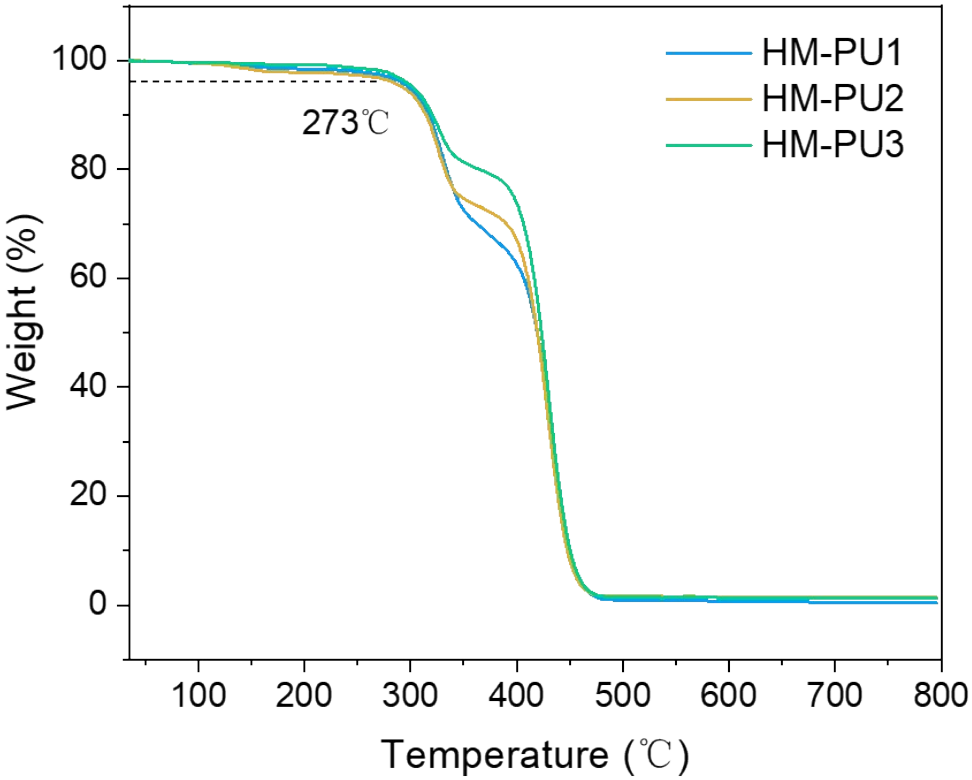

Figure S1 TGA curves of HM-PUs

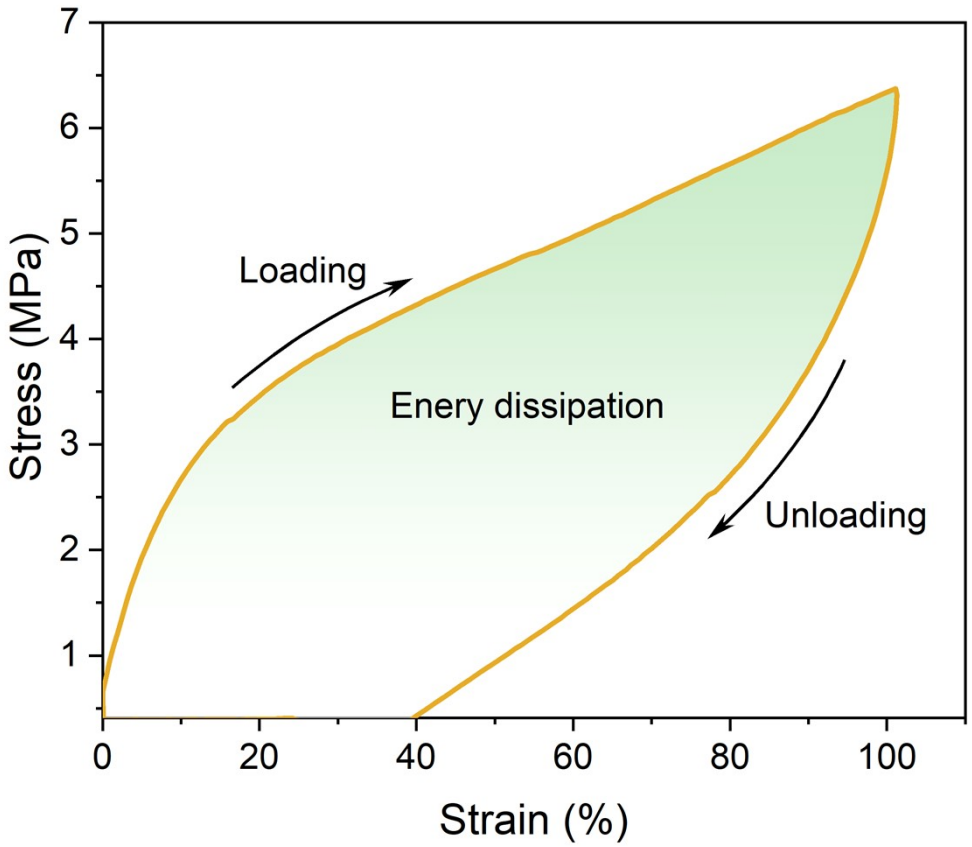

Figure S2 Typical cyclic curves of HM-PU1. The green area between the curves is the energy dissipation.

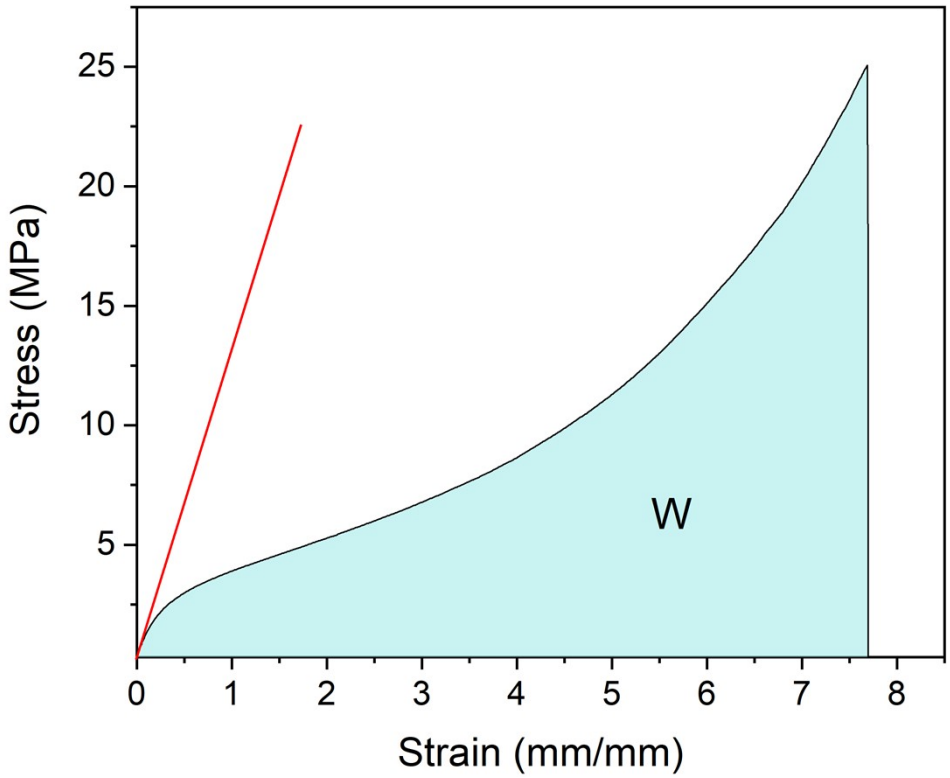

Figure S3 Calculations of Young's modulus and toughness from initial slope of the curves and the area under the curves respectively for HM-PU2

Toughness can be calculated via the following formula [1]:

$$W = \int_{\varepsilon_0}^{\varepsilon_i} \sigma d\varepsilon$$

ε_0 is the initial elongation, ε_i is the elongation at break, σ is the imposed force.

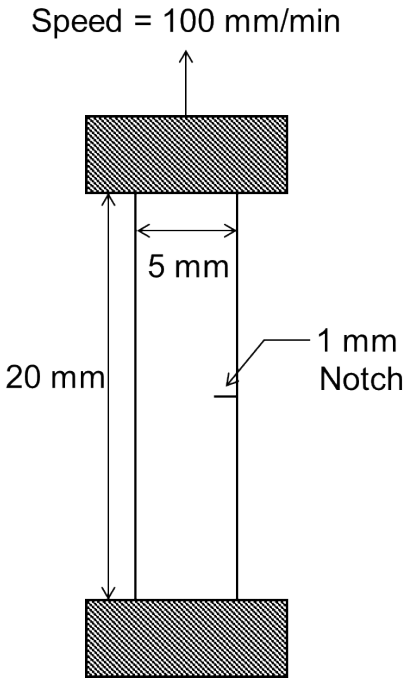

Figure S4 Schematic diagram of the notched sample under strain

The fracture energy can be calculated by the following formula [2]:

$$G_c = \frac{6Wc}{\sqrt{\lambda_c}}$$

W is the energy of unnotched sample at the elongation of λ_c, c is the notch length, λ_c is the elongation at break.

After calculation, the fracture energy of HM-PU1, HM-PU2 and HM-PU3 are 59.6 kJ m^{-2}, 60.34 kJ m^{-2} and 45 kJ m^{-2} respectively.

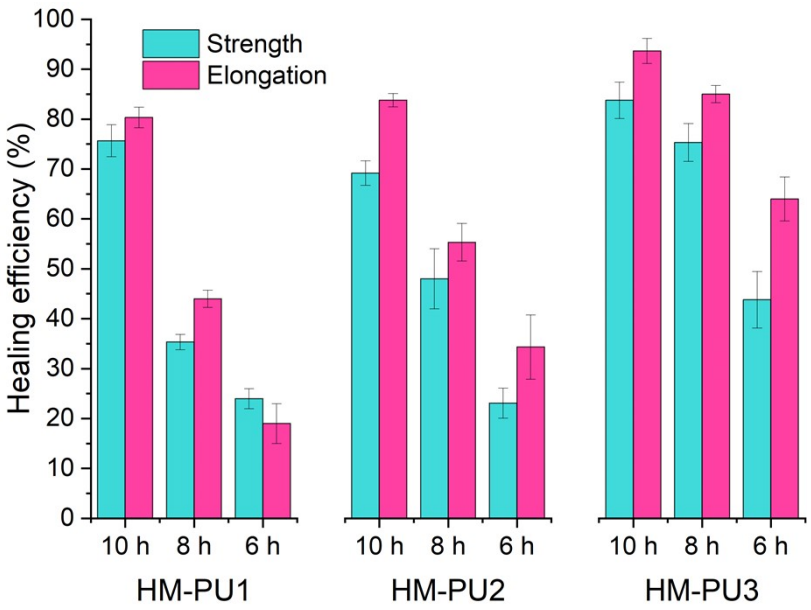

Figure S5 The self-healing efficiencies of HM-PUs

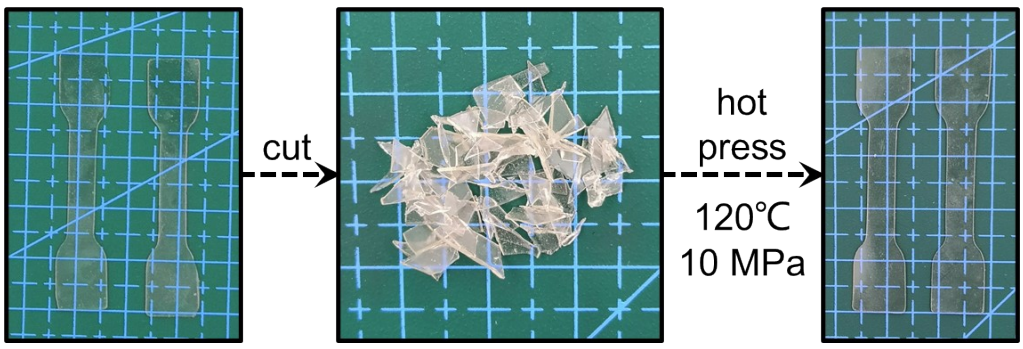

Figure S6 The recyclable process of HM-PU1 pieces under press (10 MPa) at 120℃.

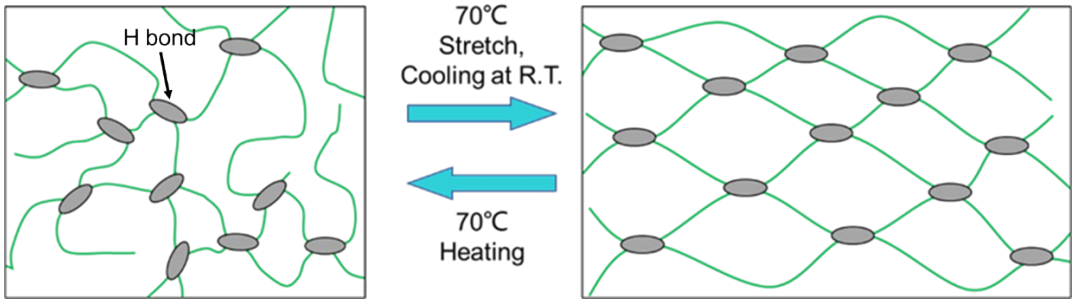

Figure S7 Schematic diagram of dynamic network transformation under heating.

References

1 H. W. Greensmith, *J. Appl. Polym. Sci.* 1963, 7 (3), 993-1002.

2 M. A. Meyers, J. Mckittrick, P. Y. Chen, *Science* 2013, 339 (6121), 773-779.