Supporting information

Rapid self-healing and tough polyurethane based on the synergy of multi-level hydrogen bonds and disulfide bonds for healing propellant microcracks

Tu Jing, Xu Heng, Xiang Guifeng, Liang Li, Li Pingyun, Guo Xiaode*

National Special Superfine Powder Engineering Research Center of China Nanjing University of Science and Technology Nanjing, Jiangsu 210094, P. R. China E-mail: guoxiaodenj@sina.com

sample	PTMG (g)	MDI (g)	IPDI (g)	APDS (g)
PU-A	5	0.00	1.15	0.62
PU-B	5	0.26	0.92	0.62
PU-C	5	0.52	0.69	0.62
PU-D	5	0.78	0.46	0.62

Table S1. The raw material ratio table of self-healing polyurethane.

Table.S2 Molecular weight information of PU-A, PU-B, PU-C, PU-D.

sample	Mn (g/mol)	Mw (g/mol)	PD (Mw/Mn)
PU-A	40622	81130	1.99
PU-B	44494	86299	1.94
PU-C	37641	64716	1.72
PU-D	30542	48637	1.59



Fig. S2. In-situ infrared spectra of C=O stretching vibration in PU-C at different temperatures.



Fig. S3. SAXS images of PU-A, PU-B, PU, C, PU-D.



Fig. S4. Loss modulus curves of four polyurethanes.



Fig. S5. (a) PU-A cyclic stretching curve with fixed strain 200%. (b) PU-B cyclic stretching curve with fixed strain 200%. (c) PU-C cyclic stretching curve with fixed strain 200%. (d) PU-D cyclic stretching curve with fixed strain 200%.



Fig. S6. (a) The stress relaxation curve measured by DMA of PU-A at 40, 60, 80, 100°C and the fitting line of the PU-A according to the Arrhenius's law. (b) The stress relaxation curve measured by DMA of PU-B at 40, 60, 80, 100°C and the fitting line of the PU-B according to the Arrhenius's law. (c) The stress relaxation curve measured by DMA of PU-D at 40, 60, 80, 100°C and the fitting line of the PU-D according to the Arrhenius's law.



Fig. S7. Stress-strain curve of PU at 60°C for different healing time. (a) PU-A. (b) PU-B. (c) PU-C. (d) PU-D.



Fig. S8. (a), (b) The optical microscope image of scratch change on PU-A and PU-B surface after healing at 60°C for 5 h. (c) The optical microscope image of scratch change on PU-D surface after healing at 60°C for 5 h and 10h.