Electronic Supplementary Material (ESI) for Polymer Chemistry.

Supporting information

A healable, re-cyclable and thermochromic epoxy resin for thermal-responsive smart windows

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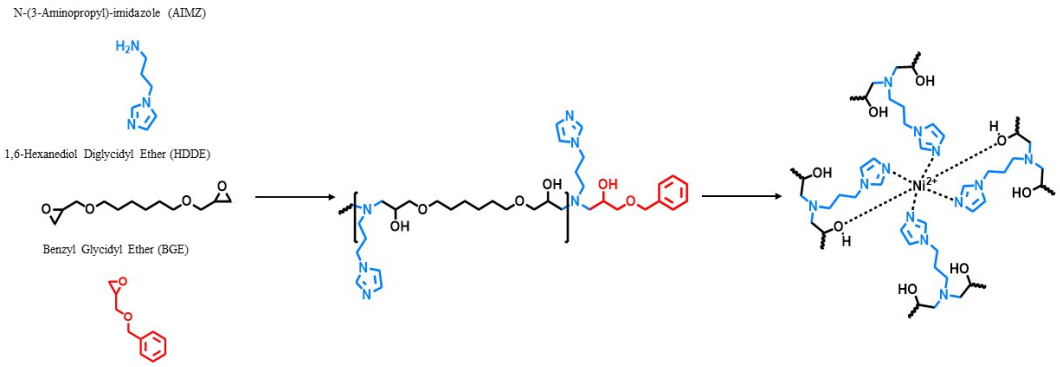

Figure S1. Scheme of synthetic route.

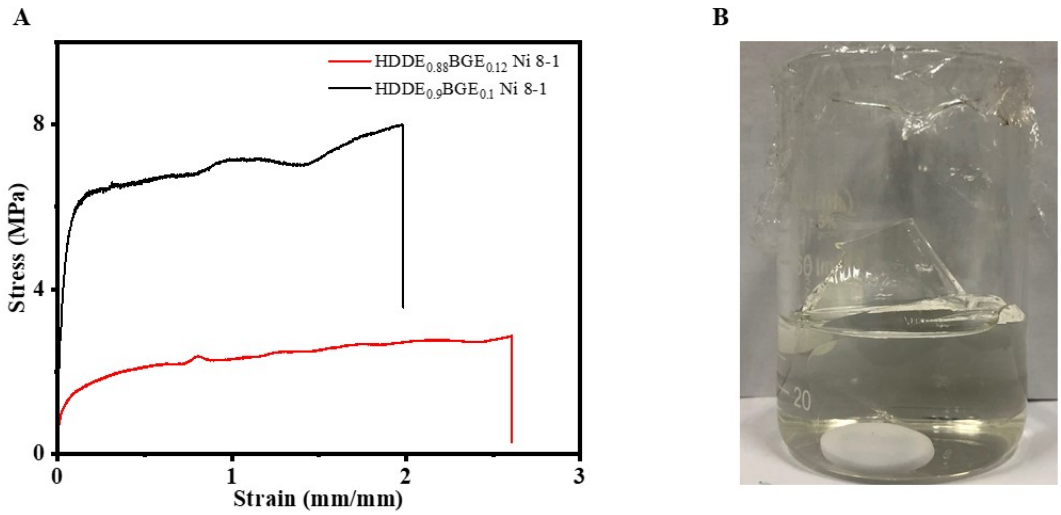

Figure S2. A. stress-strain curves of $HDDE_{0.88}BGE_{0.12}$ Ni 8-1 and $HDDE_{0.90}BGE_{0.10}$ Ni 8-1 at stretching speed of 10 mm/min; B. image of $HDDE_{0.92}BGE_{0.08}$-IMZ.

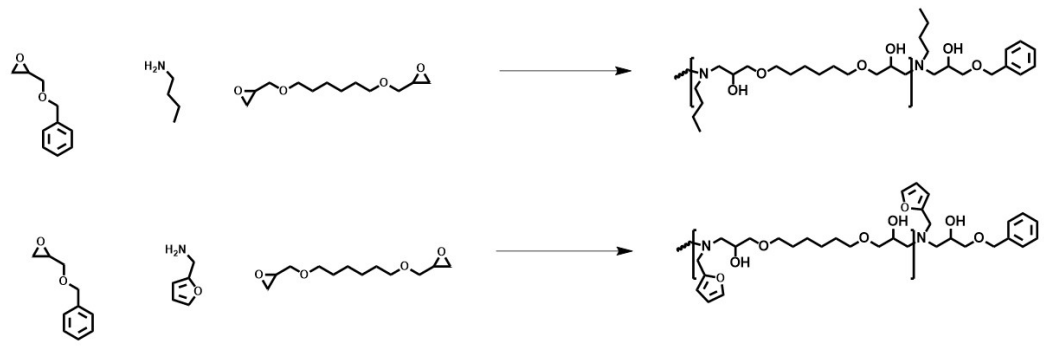

Figure S3. Synthetic route of $HDDE_{0.9}BGE_{0.1}$-BA (Top) and $HDDE_{0.9}BGE_{0.1}$-FFA (Bottom).

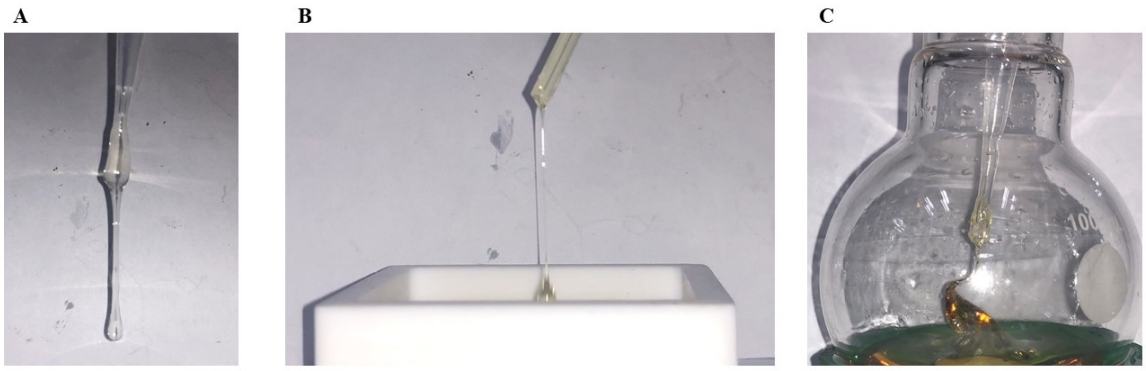

Figure S4. Images of $HDDE_{0.9}BGE_{0.1}$-BA (A); $HDDE_{0.9}BGE_{0.1}$-FFA (B); $HDDE_{0.9}BGE_{0.1}$-IMZ (C).

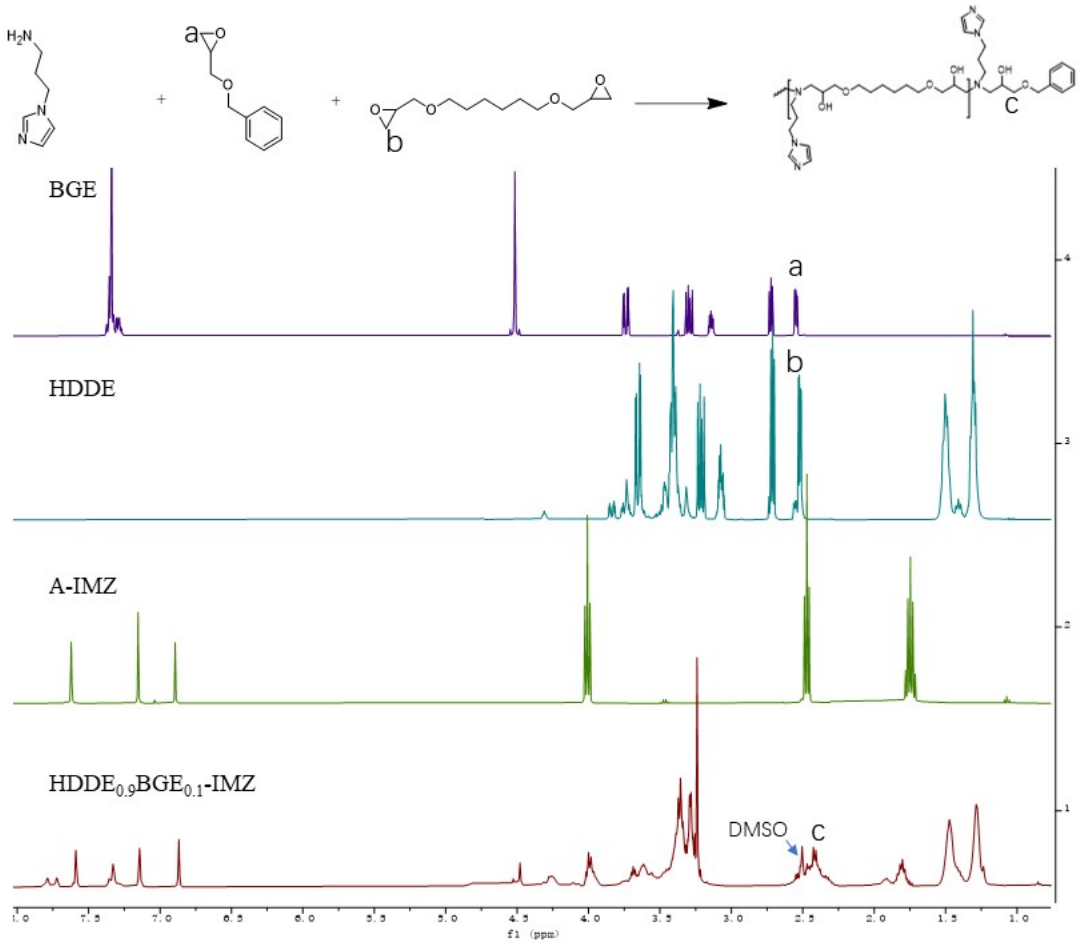

Figure S5. ^{1}H NMR of BGE, HDDE, AIMZ, $HDDE_{0.9}BGE_{0.1}$-IMZ (400MHz, DMSO), a, b, c represents the characteristic peaks of epoxy resin of BGE, HDDE, $HDDE_{0.9}BGE_{0.1}$-IMZ, respectively.

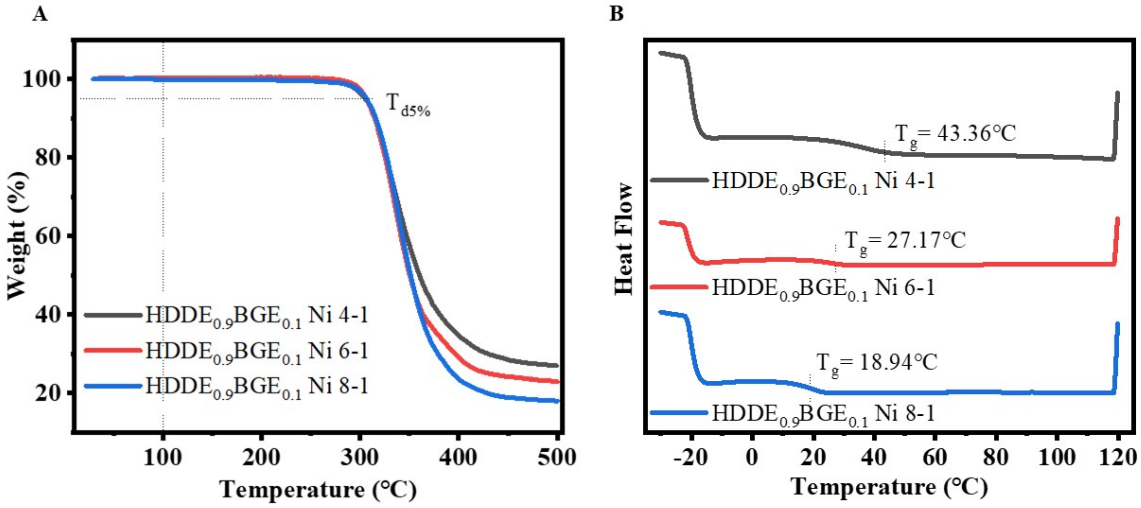

Figure S6. A. TG curves of epoxy resin with different cross-link densities; B. DSC curves of epoxy resin with different cross-link densities.

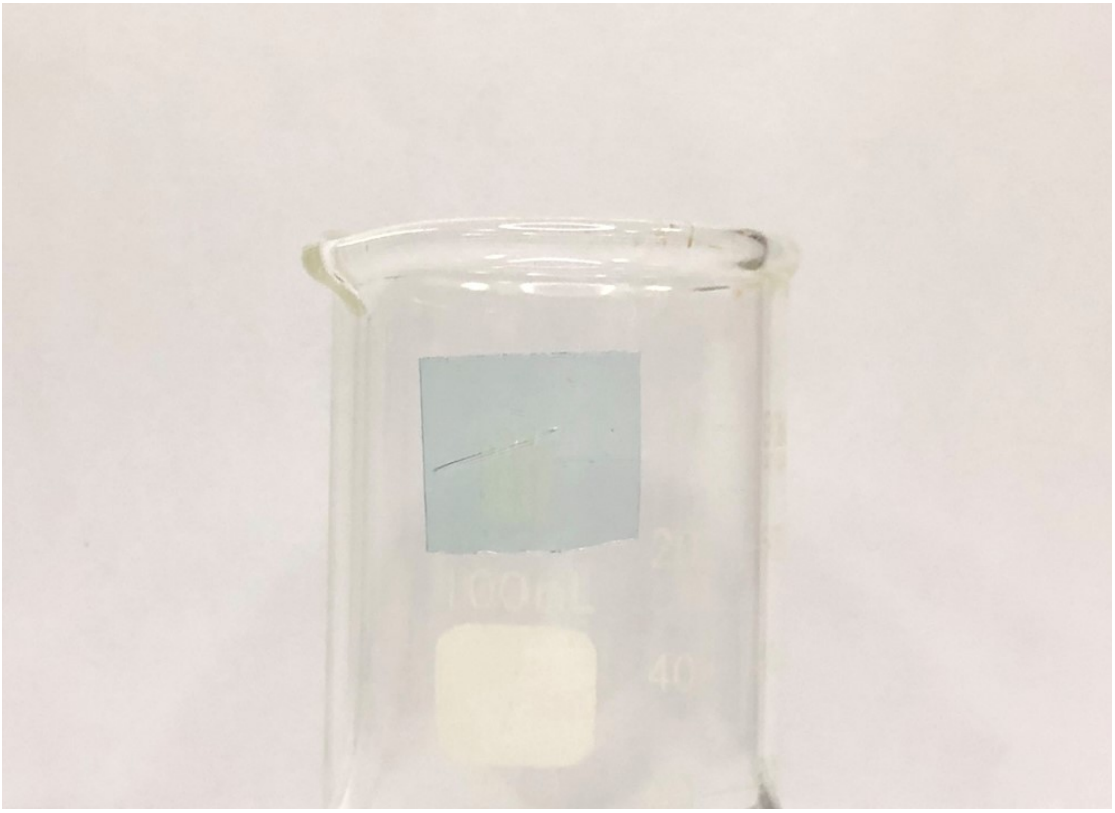

Figure S7. The sample self-adapts to the irregular surface.

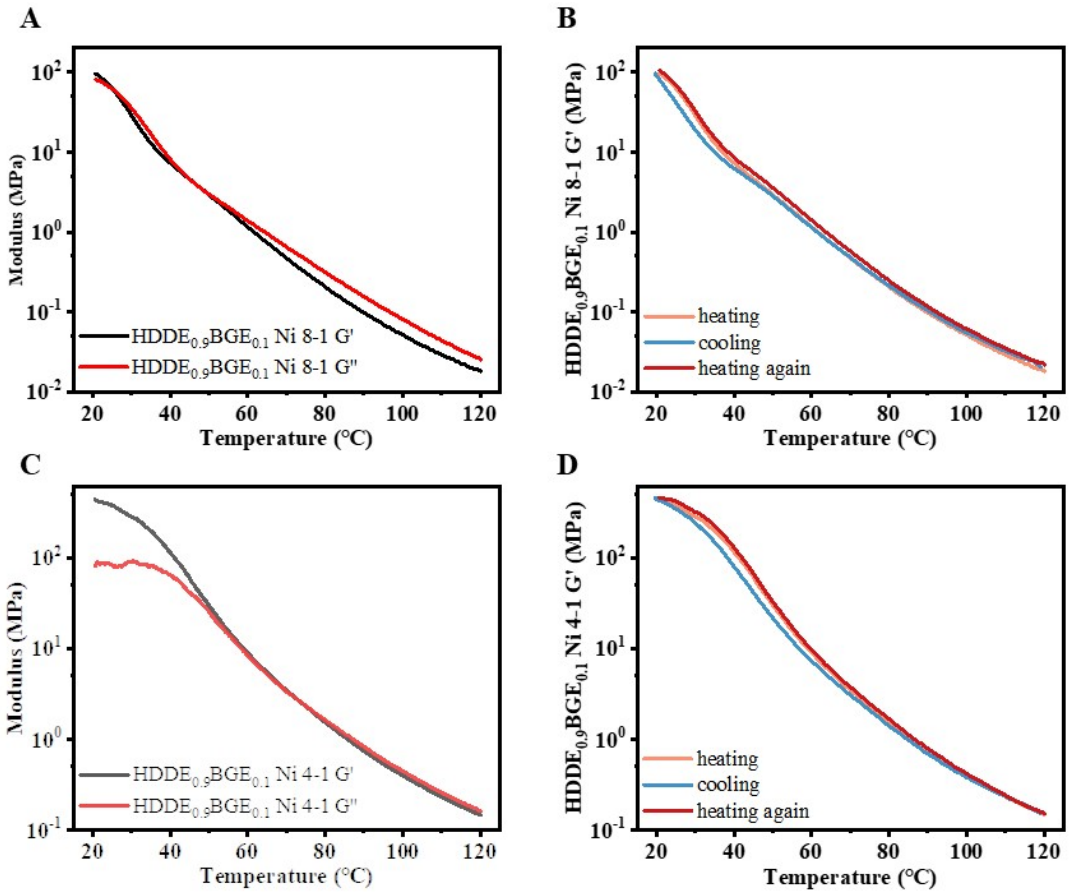

Figure S8. A, C. temperature dependent rheology measurements of $HDDE_{0.9}BGE_{0.1}$ Ni 8-1 and 4-1; B, D. cyclic temperature-sweep rheology measurements of $HDDE_{0.9}BGE_{0.1}$ Ni 8-1 and 4-1 (temperature changing rate 2 °C/min).

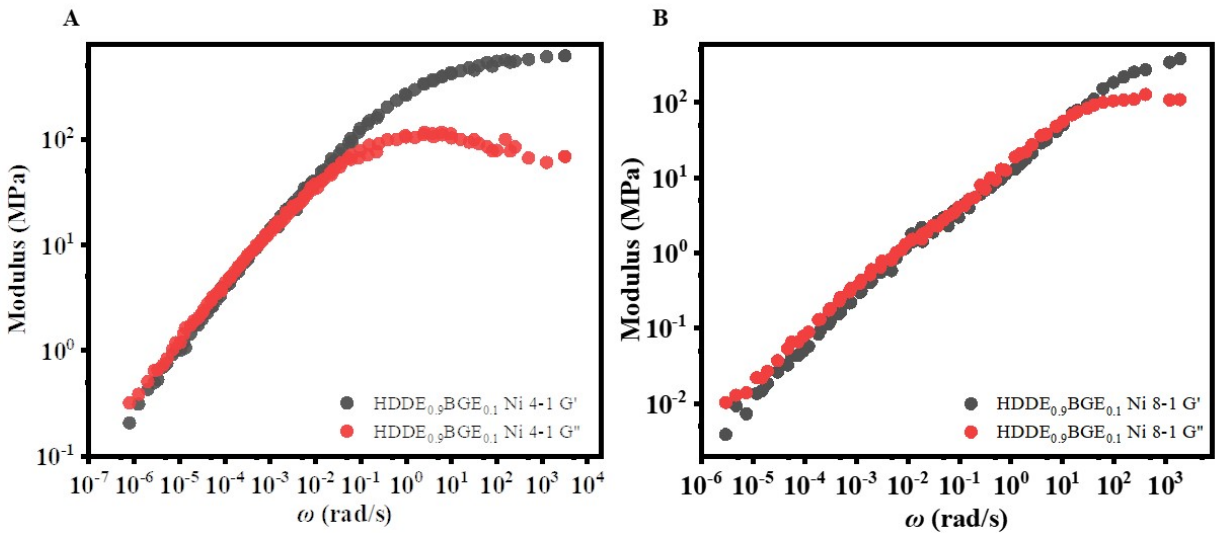

Figure S9. Master curves of $HDDE_{0.9}BGE_{0.1}$ Ni 4-1 (A), $HDDE_{0.9}BGE_{0.1}$ Ni 8-1 (B) at a reference temperature of 25 °C.

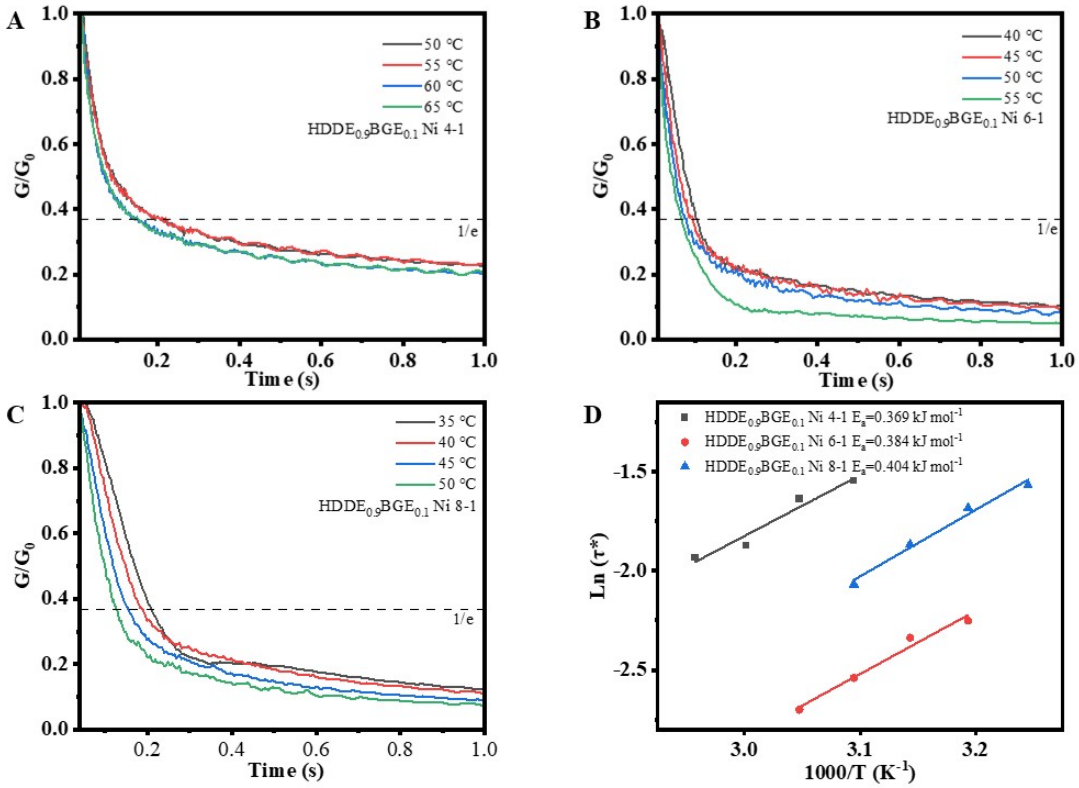

Figure S10. Stress relaxation of epoxy resin at different temperatures A. $HDDE_{0.9}BGE_{0.1}$ Ni 4-1; B. $HDDE_{0.9}BGE_{0.1}$ Ni 6-1; C. $HDDE_{0.9}BGE0_{.1}$ Ni 8-1; D. arrhenius plots of the characteristic relaxation time τ* versus 1000/T for epoxy resin.

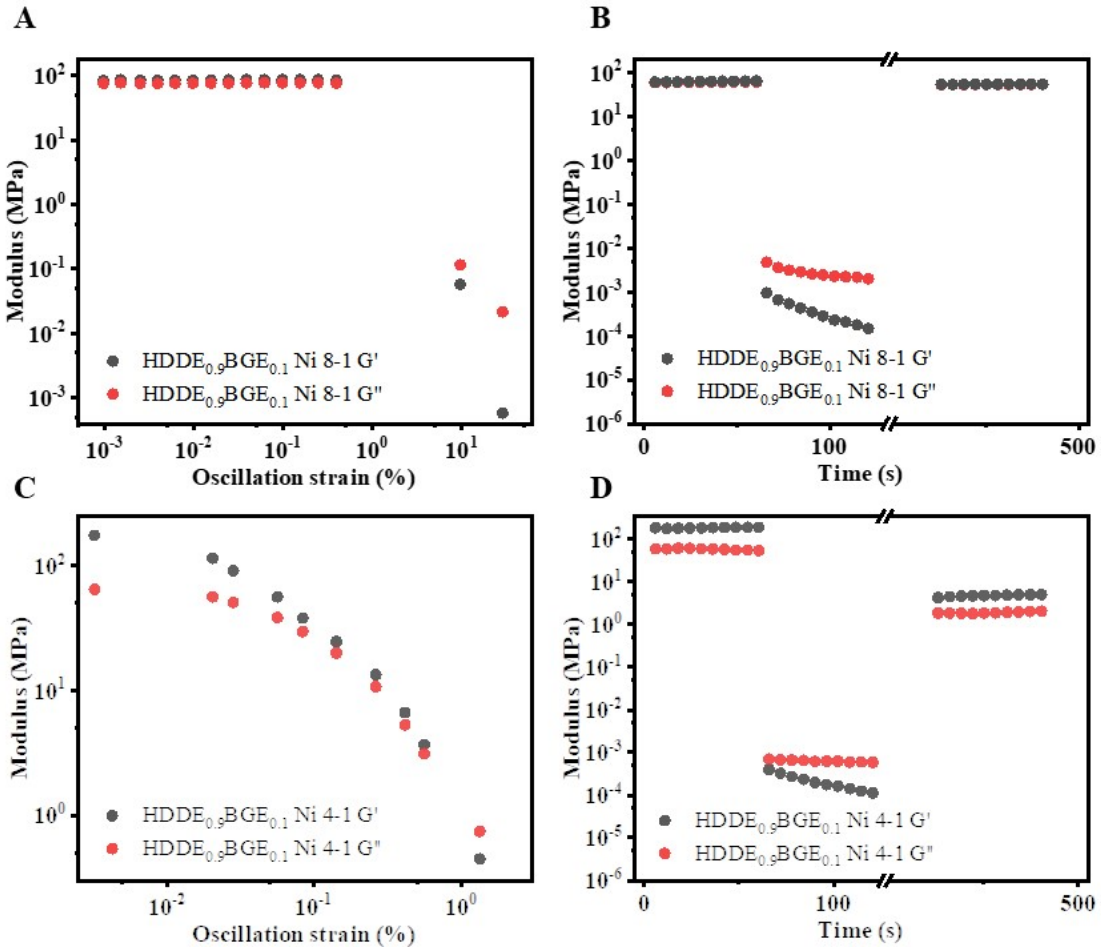

Figure S11. A. storage modulus (G′) and loss modulus (G″) versus oscillation of $HDDE_{0.9}BGE_{0.1}$ Ni 8-1; B. continuous amplitude sweep experiment of $HDDE_{0.9}BGE_{0.1}$ Ni 8-1, small amplitude scans (0.01 %), and large amplitude scans (10 %); C storage modulus (G′) and loss modulus (G″) versus oscillation of $HDDE_{0.9}BGE_{0.1}$ Ni 4-1; D. continuous amplitude sweep experiment of $HDDE_{0.9}BGE_{0.1}$ Ni 4-1, small amplitude scans (0.001 %), and large amplitude scans (1 %).

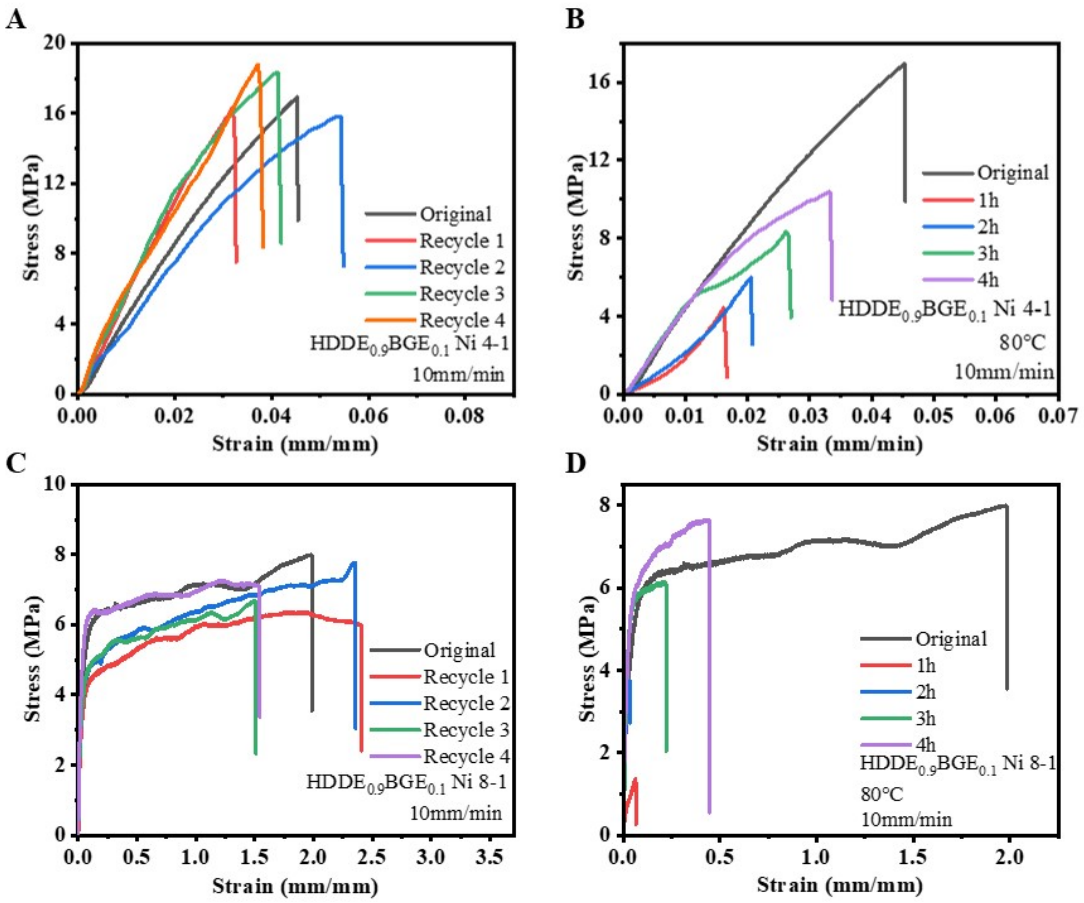

Figure S12. A. stress-strain curves of the original and recycle of $HDDE_{0.9}BGGE_{0.1}$ Ni 4-1; B. stress-strain curves of the original and self-healing of $HDDE_{0.9}BGE_{0.1}$ Ni 4-1; C. stress-strain curves of the original and recycle of $HDDE_{0.9}BGE_{0.1}$ Ni 8-1; D. stress-strain curves of the original and self-healing of $HDDE_{0.9}BGE_{0.1}$ Ni 8-1;

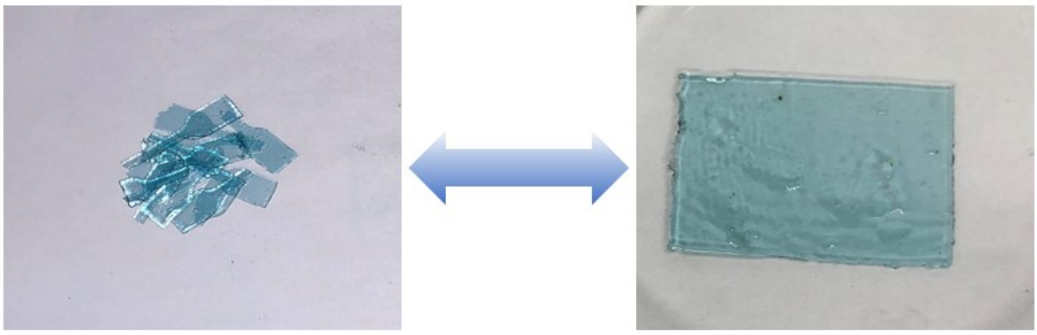

Figure S13. Recycle of coordination bonds modified epoxy resin.

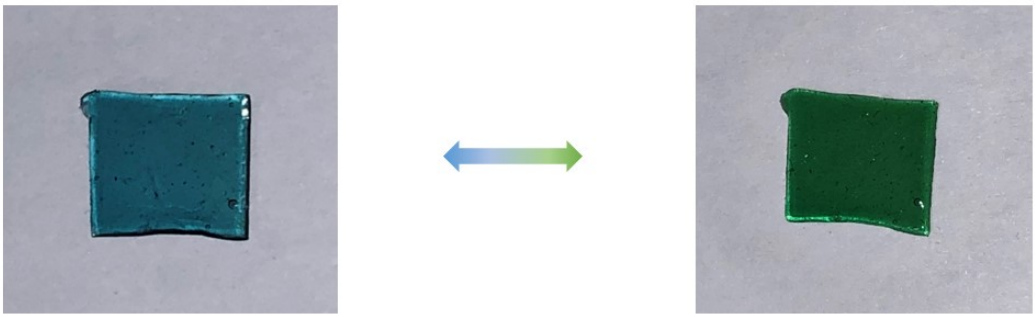

Figure S14. The color of the sample changes reversibly between room temperature (bright blue) and 100 ℃ (dark green).

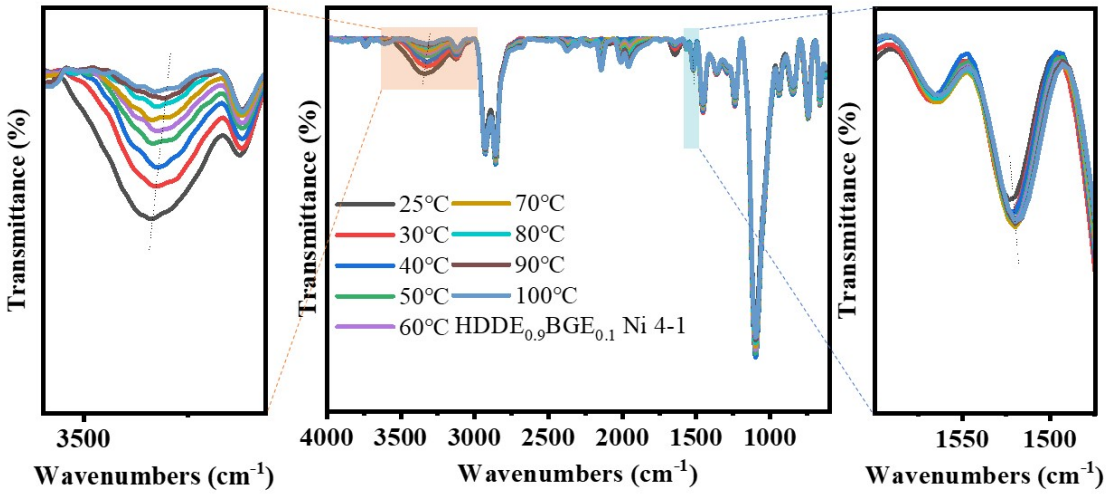

Figure S15. Variable temperature Fourier-transform infrared spectroscopy of $HDDE_{0.9}BGE_{0.1}$ Ni 4-1.

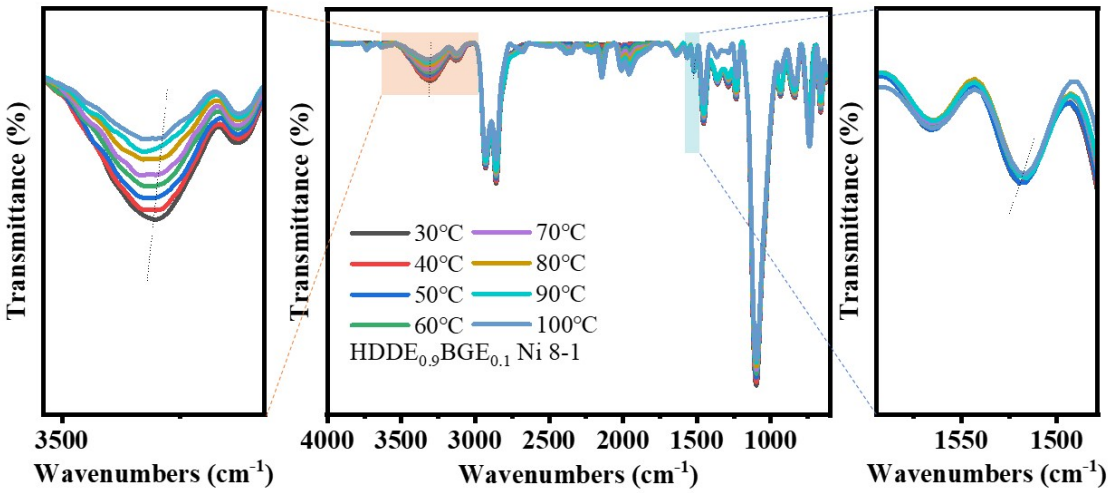

Figure S16. Variable temperature Fourier-transform infrared spectroscopy of $HDDE_{0.9}BGE_{0.1}$ Ni 8-1.

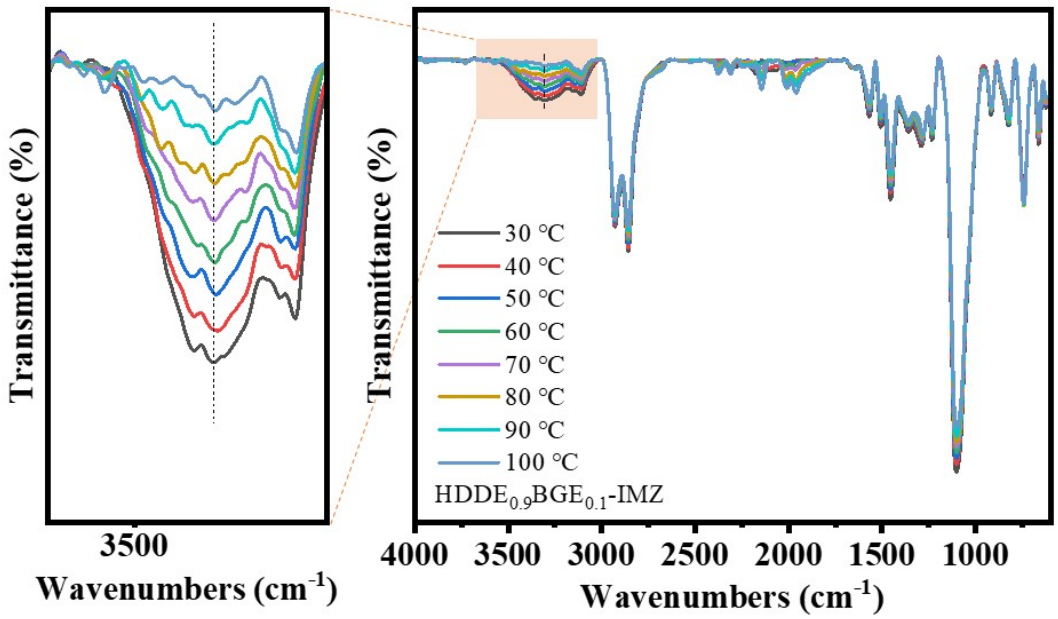

Figure S17. Variable temperature Fourier-transform infrared spectroscopy of $HDDE_{0.9}BGE_{0.1}$-IMZ.

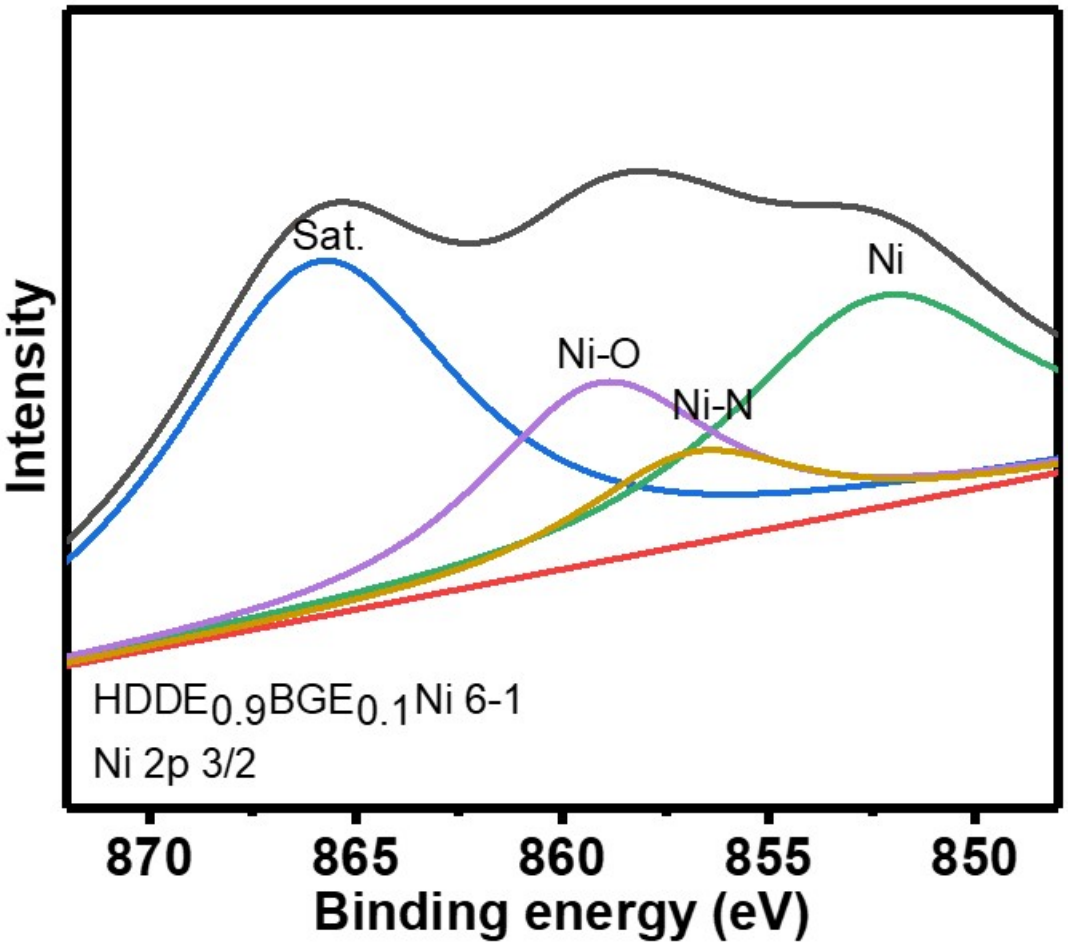

Figure S18. Ni 2p 3/2 XPS spectra of $HDDE_{0.9}BGE_{0.1}$ Ni 6-1.

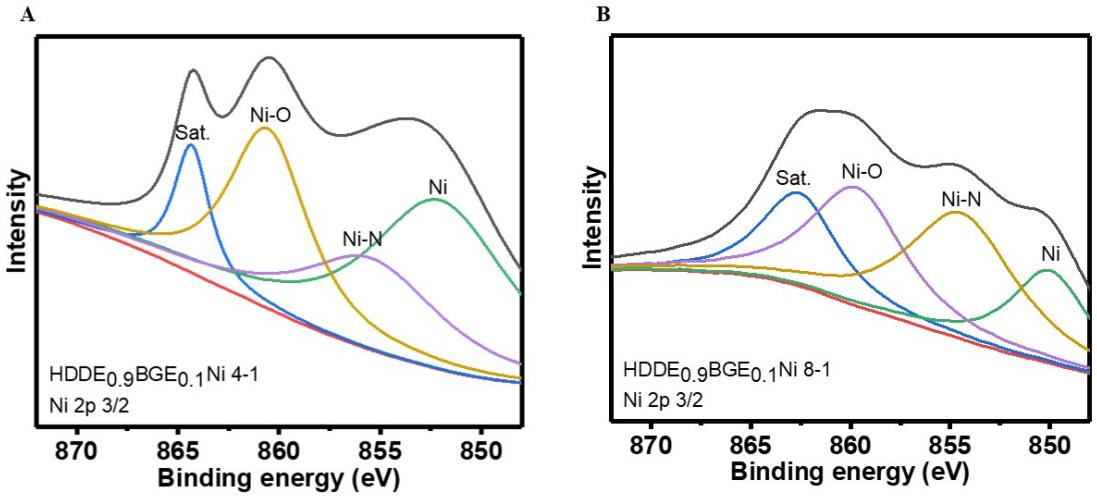

Figure S19. Ni 2p 3/2 XPS spectra of $HDDE_{0.9}BGE_{0.1}$ Ni 4-1 (A); $HDDE_{0.9}BGE_{0.1}$ Ni 8-1 (B).

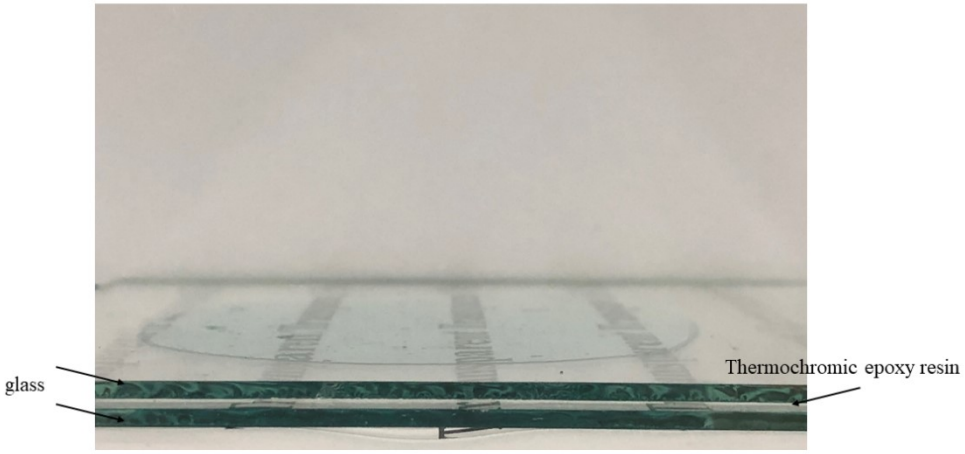

Figure S20. The scheme of a simulate smart window.

Supporting movie

Supporting movie1. The color changes from bright blue to dark green as the temperature rises from room temperature to 100 ℃.

Supporting movie2. The color changes from dark green to bright blue as the temperature drops from 100 ℃ to room temperature.