Supporting Information

Self-healing, recyclable, and removable UV-curable coatings derived from tung oil and malic acid

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S1. Determining the cycle recovery ratio for TMG-M1

The cycle recovery ratio (R_r) was determined by the following equation:

$$R_r = \frac{(L_p - L_e)}{(L_p - L_s)} \quad \textbf{(S1)}$$

Where L_p, L_s, and L_e are the predetermined strain (5%), the initial strain, and the end strain of each cycle, respectively.

S2. Determining the grafted degree of carboxylic acid for TOMA

The A_v values for TOMA products were

$$A_V = \frac{X_{MA} \times 2 \times M_{KOH} \times 1000}{M_{TO} + X_{MA} \times (M_{MA} + 18)}$$

where A_v represents acid values, M_{KOH}, M_{TO}, and M_{MA} represent the molar mass of KOH, TO, and MA, respectively. Thus the grafted degree of carboxylic acid (X_{CA}) can be calculated:

$$X_{CA} = 2X_{MA} = \frac{2A_V \times M_{TO}}{2000 \times M_{KOH} - A_V \times ((M_{MA} + 18)} \quad \textbf{(S2)}$$

S3. Determining the grafted C=C functionality ($N_{C=C}$) for TMG.

$$N_{C=C} = \frac{A_{5.61-6.17\,ppm}/2}{A_{0.88\,ppm}/9} = \frac{9A_{5.61-6.17\,ppm}}{2A_{0.88\,ppm}} \quad \textbf{(S3)}$$

S4. Determining the cross-link density (v_e).

The cross-link density of the cured materials was calculated using the following equation:

$$\nu_e = \frac{E'}{3RT} \qquad \textbf{(S4)}$$

where E' is the storage modulus of the cross-linked materials in the rubber state (the E' at T_g+60 °C was used for the determination of ν_e in this work)), R is the gas constant, and T is the absolute temperature.

S5. Acid values of TMG.

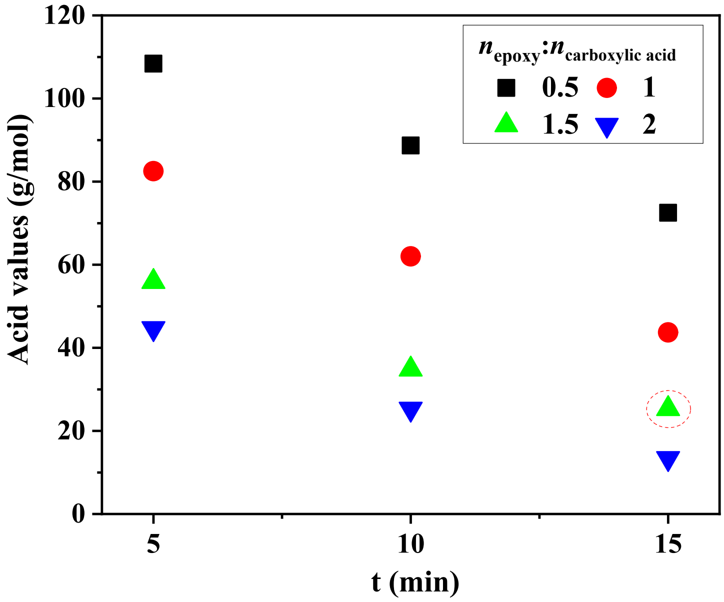

Fig. S1 Acid values of TMG.

S6. ^{1}H NMR spectrum of TMG.

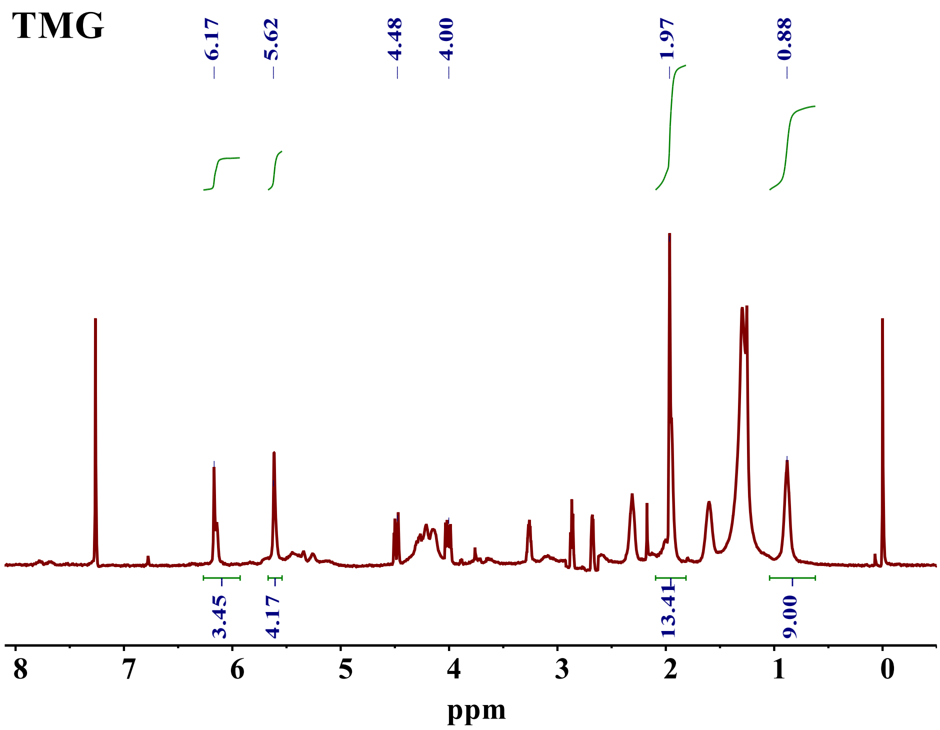

Fig. S2 ^{1}H NMR spectrum of TMG.

S7. DSC curves of TMG-M1 before and after heating.

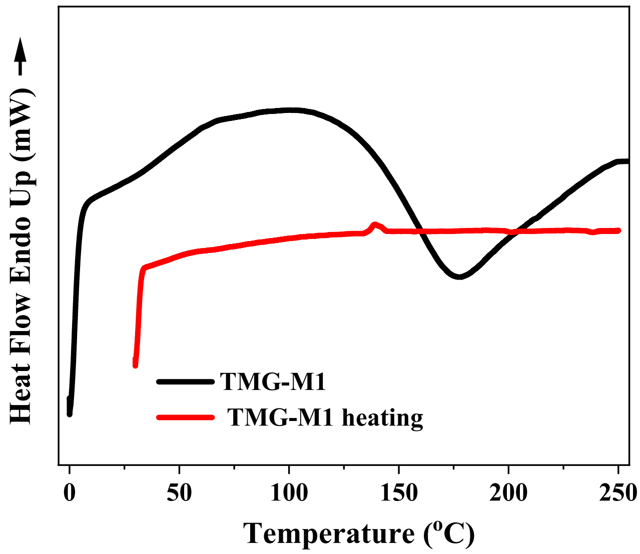

Fig. S3 DSC curves of TMG-M1 before and after heating at 180 °C for 1 h.

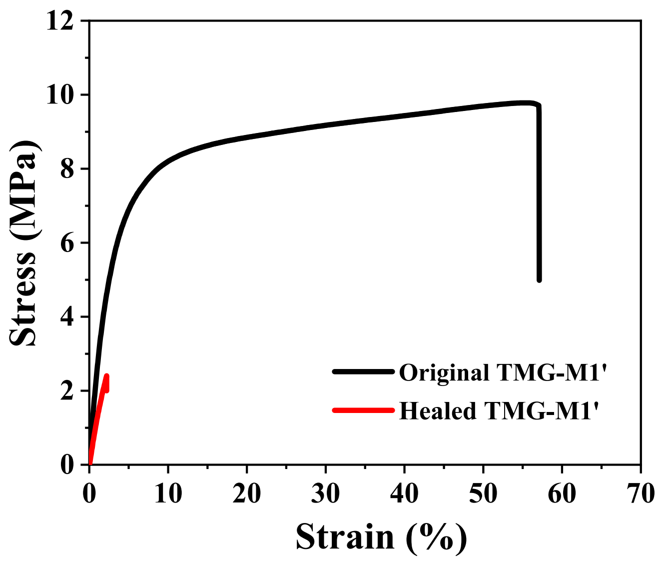

Fig. S4 Comparison of tensile properties of the original and healed TMG-M1′ samples.

S8. Comparison of the effects of dynamic TER or further cross-linking on the seal-healing properties

A sample with the same composition as TMG-M1 but without the $Zn(acac)_2$ catalyst, named as TMG-M1′, was prepared and used for the self-healing tests. After welding at 180 °C for 10 min, the tensile strength and modulus of the healed TMG-M1′ sample were 1.9 MPa and 52.7 MPa (**Fig. S4**), respectively, which were much lower than the healed TMG-M1 sample (12.2 MPa and 178.2 MPa). The welding efficiencies of tensile strength and modulus were only 15.6% and 25.8%, respectively, also much lower than those of TMG-M1 (171.8% and 124.0%). These results not only indicated the self-healing ability was very limited if without the effect of dynamic TERs activated by the catalyst, but also implied that the dynamic TERs played a more important role than the further cross-linking in the self-healing process.

S9. Removability of the UV-cured coatings

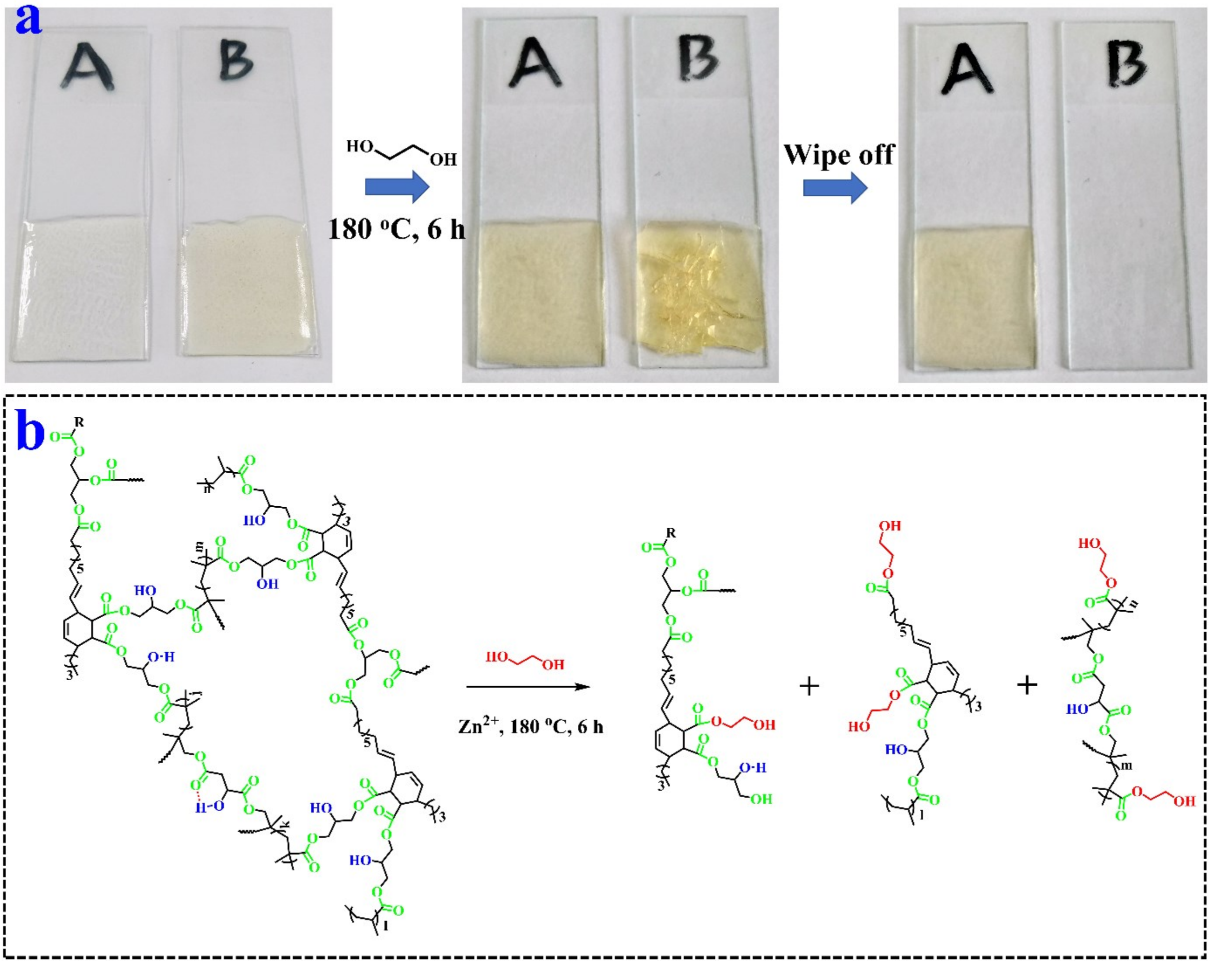

Fig. S5 (a) Removable test of UV-cured coatings by immersing the samples (A: TMG-M1′; B: TMG-M1) into glycol solvent at 180 °C for 6 h and wiping off; (b) possible mechanism of dynamic TERs with the assistance of glycol.

S10. Shape fixity ratios and shape recovery ratios during consecutive dual-shape memory cycles.

Table S1 Shape fixity ratios (S_f) and shape recovery ratios (S_r) during consecutive dual-shape memory cycles.

Samples	S_f (%)	S_r (%)
Cycle 1	98.2	92.0

Cycle 2	98.0	87.5
Cycle 3	98.0	85.4
Cycle 4	97.5	84.6