Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Supporting Information

Photothermal-triggered shape memory coatings with active repairing and corrosion sensing properties

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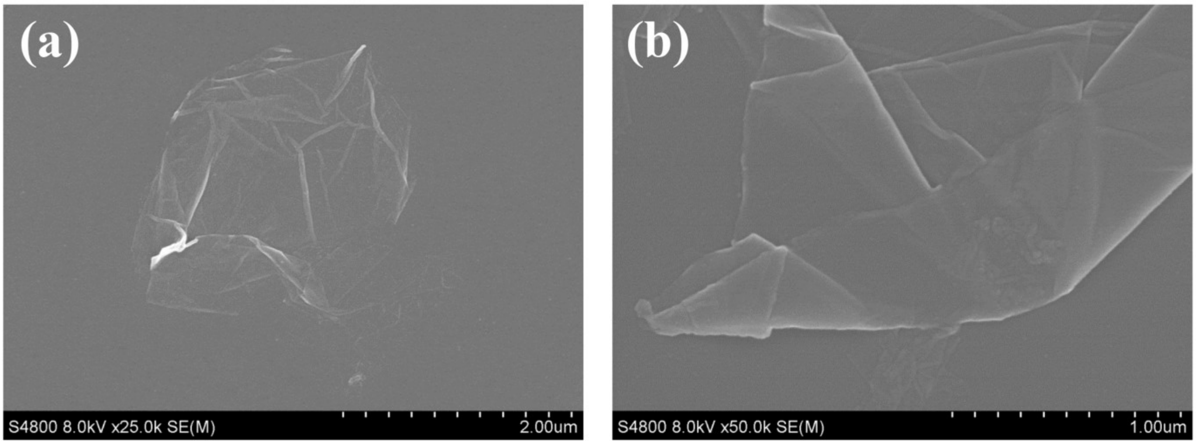

Fig. S1 SEM images of (a) GO and (b) PPG nanosheets.

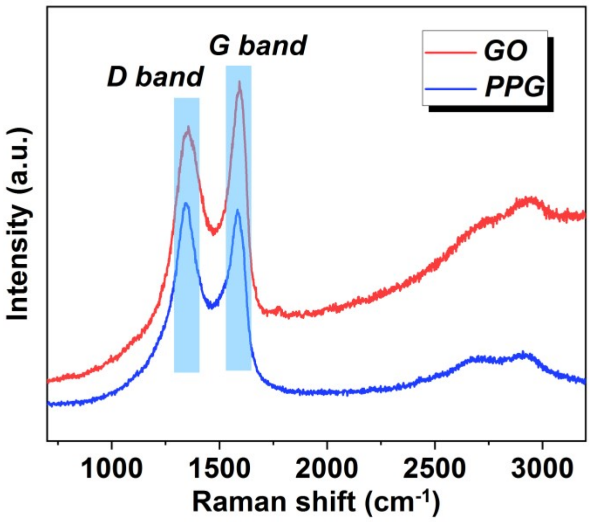

Fig. S2 Raman spectra of GO and PPG nanosheets under 532 nm of excitation wavelength.

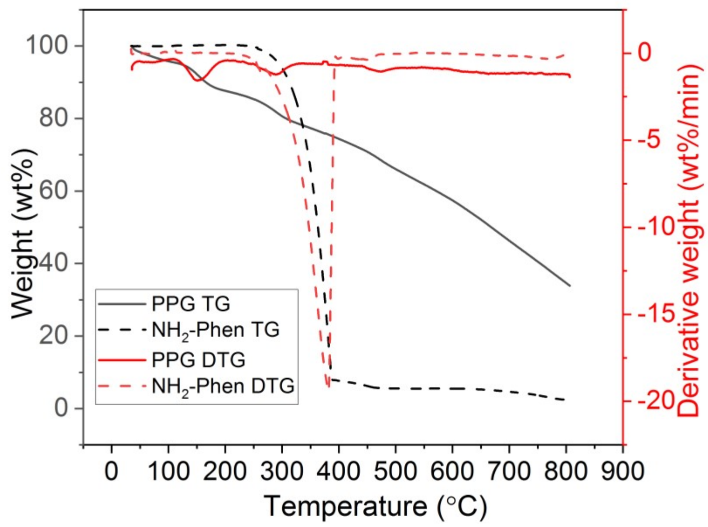

Fig. S3 Thermal gravity (TG) and differential thermal gravity (DTG) analysis of NH_2-Phen and PPG nanosheets.

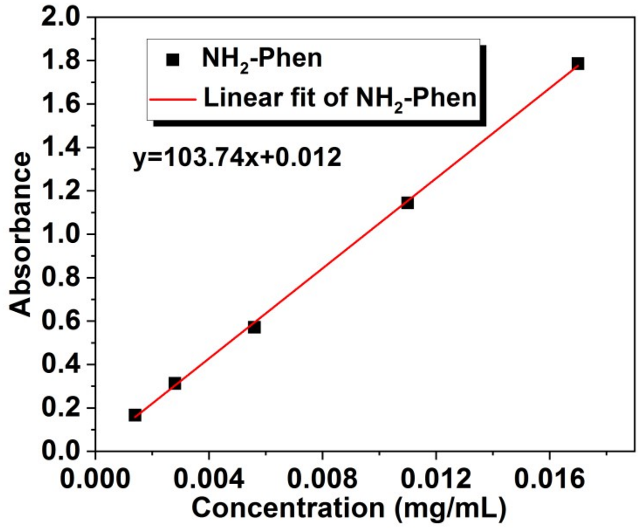

Fig. S4 The linear relationship between absorbance and concentration of NH_2-Phen in 3.5 wt% NaCl solution.

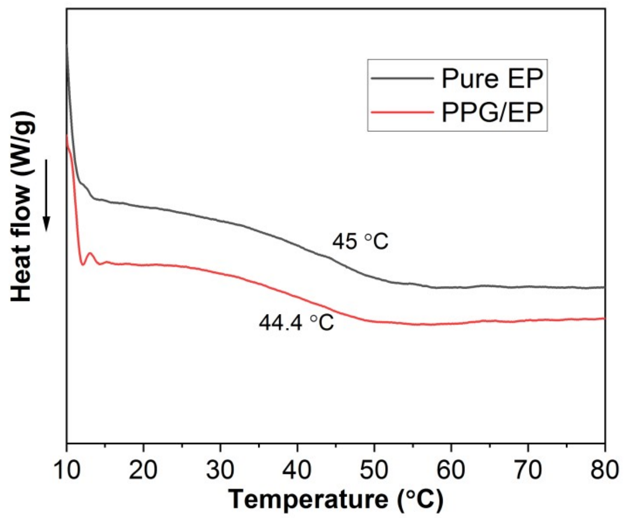

Fig. S5 Differential scanning calorimeter (DSC) heating curves of pure EP and PPG/EP.

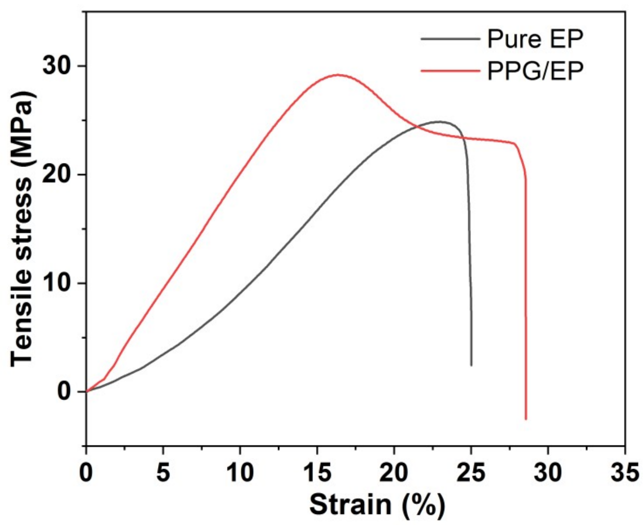

Fig. S6 Stress-strain curves of pure EP and PPG/EP at room temperature.

Table S1 Material properties of pure EP and PPG/EP.

Samples	Tensile strength (MPa)	Strain at break (%)	Toughness (MJ m^{-3})	Adhesion strength (MPa)	Coefficient of thermal expansion (20 to 120 ºC, ppm/ºC)
Pure EP	24.8 ± 1.8	23.3 ± 1.3	4.3 ± 0.2	8.5 ± 0.3	127
PPG/EP	29.2 ± 2.2	27.7 ± 2.1	8.4 ± 0.3	9.6 ± 0.8	132

Table S2 Surface temperature of coatings with different PPG content after irradiating for 90 s (0.8 W/cm^2).

PPG content (wt%)	0	0.5	1	2
Maximum temperature (ºC)	19.6	55.6	105	107

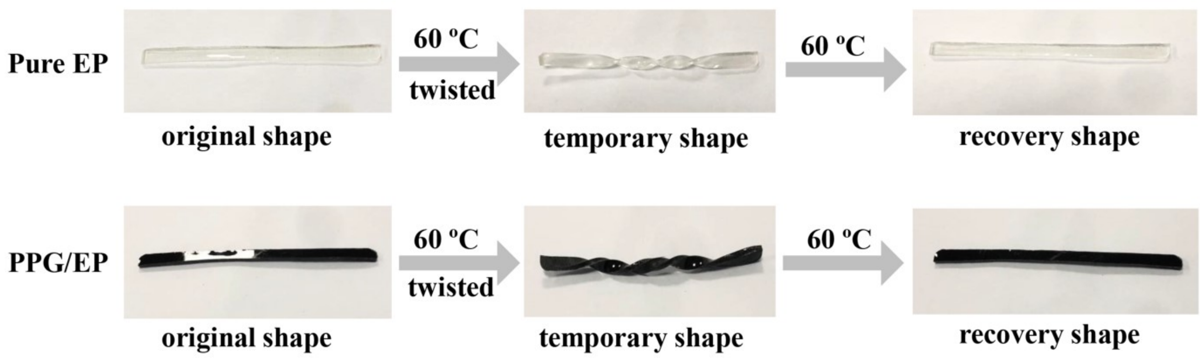

Fig. S7 Shape memory behaviors of Pure EP and PPG/EP. Shape programming was achieved by heating the polymers to 60 °C, and followed by cooling to room temperature. Shape recovery process was achieved by reheating the samples to 60 °C.

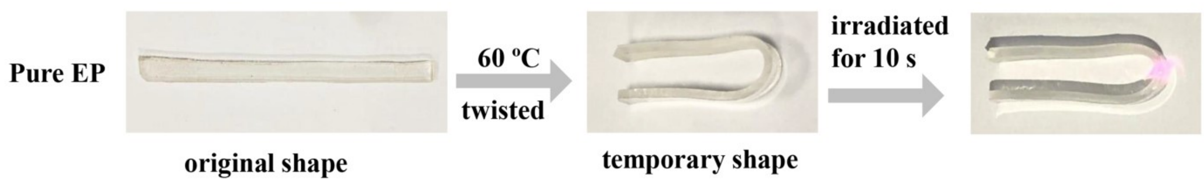

Fig. S8 The failed shape recovery process of pure EP under 10 s of NIR irradiation.

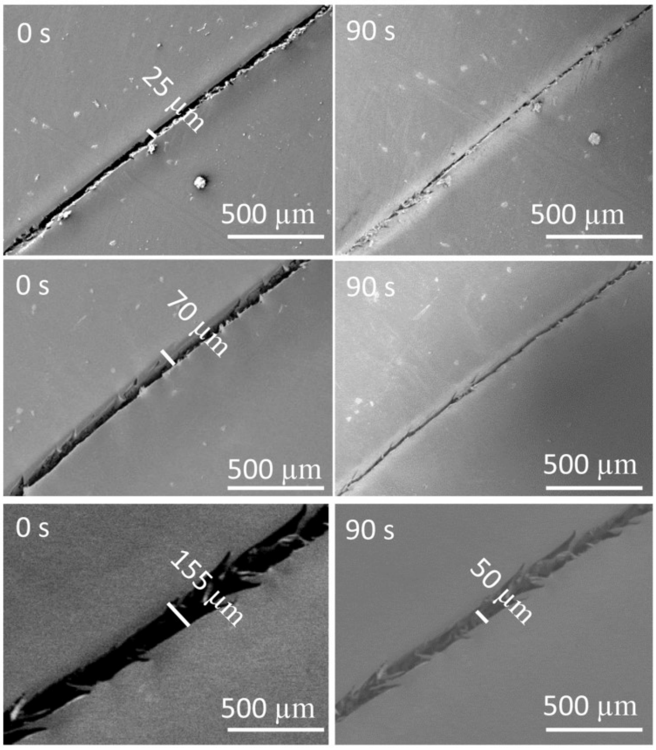

Fig. S9 SEM images of PPG/EP with different crack width after 90 s of NIR irradiation (0.8 W/cm^2).

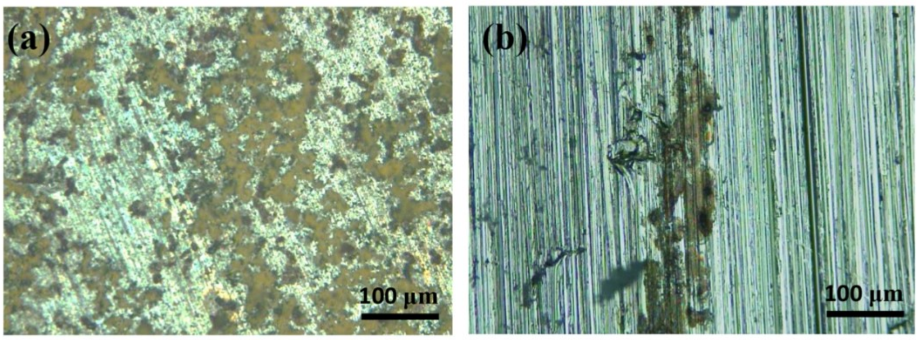

Fig. S10 Optical images of carbon steels immersed in 3.5 wt% NaCl solution for 24 h: (a) without Phen, (b) with Phen.

Table S3 Comparison of the anticorrosion performance of the scratched coatings in neutral NaCl solution (for carbon steel substrates).

Coatings	Immersion time	$Z_{f=0.01\ Hz}$ (Ω cm^2)	Reference
Irradiated PPG/EP	1 h	4.24×10^6	This work
	15 days	4.15×10^5	
MSNs−BTA@PDA/ water-borne alkyd coatings	1 day	7.4×10^4	Ref. 59 *ACS Appl. Mater. Interfaces*, 2019, **11**, 10283
GO-PDA-Zn/EP	120 h	5.8×10^4	Ref. 71 *Chem. Eng. J.* 2020, **391**, 123630
GO/ZIF-8/Epoxy	72 h	7.9×10^4	Ref. 72 *Carbon* 2020, **161**, 231
ZHM-E3/EP	7 days	1.5×10^5	Ref. 73 *ACS Appl. Mater. Interfaces*, 2020, **12**, 19823
PMB/EP	15 days	1.77×10^5	Ref. 74 *J. Mater. Sci. Technol.* 2021, **80**, 36

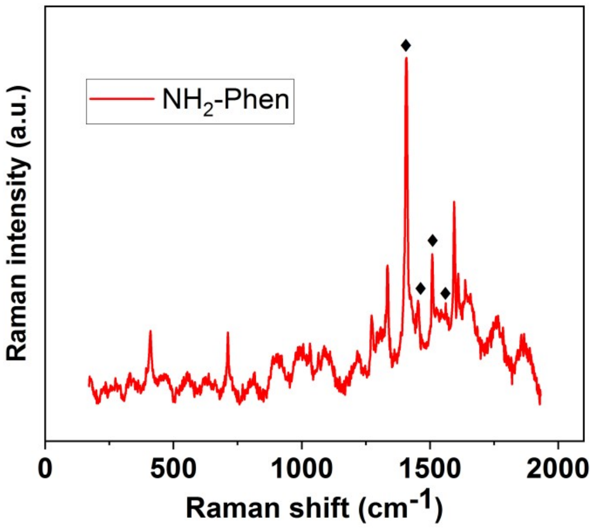

Fig. S11 Raman spectrum of NH_2-Phen powders.

Table S4 Comparison of functional properties between the work and reported smart anticorrosion coatings.

Coatings	First repair step-“close”	Second healing step-“healing”	Corrosion sensing	Reference
PPG/EP	Yes	Yes	Yes	This work
Microcapsule/polymer	No	Yes	No	Ref. 3 *Adv. Mater.*, 2009, **21**, 645
PUU–g-C_3N_4 NS	Yes	Yes	No	Ref. 6 *J. Mater. Chem. A*, 2018, **6**, 5887
BTA/SMP	Yes	Yes	No	Ref. 8 *J. Mater. Chem. A*, 2017, **5**, 2355
Polyelectrolyte/inhibitor sol-gel	No	Yes	No	Ref. 11 *Adv. Mater.*, 2008, **20**, 2789
Silicon/polyelectrolyte/BTA sol-gel	No	Yes	No	Ref. 12 *Chem. Mater.*, 2007, **19**, 402
MSNPS-SNAP	Yes	Yes	No	Ref. 13 *J. Mater. Chem. A*, 2016, **4**, 8041
SF-SHAC	No	Yes	No	Ref. 15 *ACS Appl. Mater. Interfaces*, 2019, **11**, 4425
PCL-SMASH	Yes	Yes	No	Ref. 18 *ACS Macro. Lett.*, 2013, **2**, 152
CNT hybrids	Yes	No	No	Ref. 27 *ACS Appl. Mater. Interfaces*, 2017, **9**, 27213
PMA-X-1	No	No	Yes	Ref. 35 *Nat. Chem.*, 2012, **4**, 559
SP mechanophores	No	No	Yes	Ref. 36 *J. Am. Chem. Soc.*, 2010, **132**, 16107
Encapsulated DCF/epoxy	No	No	Yes	Ref. 38 *Adv. Mater.*, 2016, **28**, 2189

Microcapsule/epoxy	No	Yes	Yes	Ref. 40 *Chem. Mater.*, 2019, **31**, 2611