Electronic Supplementary Material (ESI) for New Journal of Chemistry.

Supporting Information

Rapidly self-healing, magnetic controllability, stretchable, smart, moldable nanoparticle composite gel

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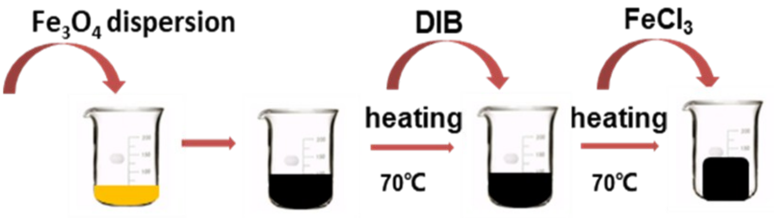

Fig. S1. The fabrication process of magnetic gel.

Firstly, a certain amount of Fe_3O_4 was added into DMF and then ultrasonic treatment to guarantee homogeneous dispersion. Then, TA was dissolved in the mixture under stirred and the mixture was heated at 70 °C until a black low viscosity liquid was got. DIB was added to link with terminal radicals to improve metastability, and stirred at 70 °C, then black high viscosity fluid could be got. A certain amount of $FeCl_3$ was added to the system under agitation, and the fluid directly changes to a gel state.

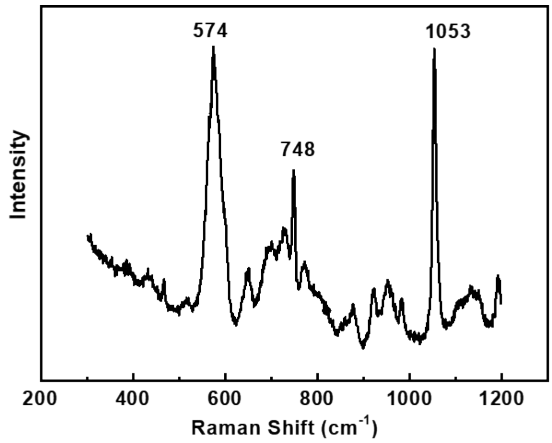

Fig. S2. The Raman spectra of poly (TA-DIB-Fe^{3+}) gel.

The vibrations in the Raman spectrum of the disulfide bond and the aromatic skeleton produced by the sulfurized DIB are shown at 574 and 1053 cm^{-1}, respectively. The peak at about 748 cm^{-1} indicated the presence of benzyl-C-S bonds, showing successful covalent crosslinking between TA and DIB.

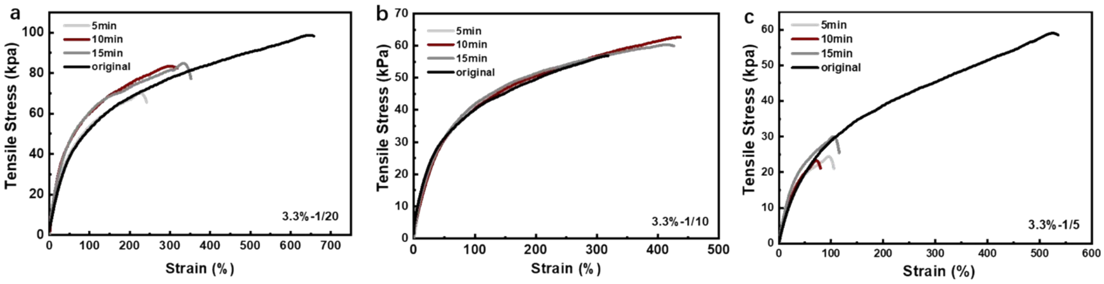

Fig. S3 (a-c) Tensile stress-strain curves of original magnetic gel with different content of $FeCl_3$ (1/20, 1/10, 1.5 of the molar amount of TA), and the curves of healed magnetic gel.

Three kinds of $FeCl_3$ (molar ratio to TA of 1/20, 1/10, 1/5) are explored. These gels were cut and then contacted for 5 min, 10 min, and 15 min, respectively. And the stress-strain curves of these TA magnetic gels are obtained, which could be used to calculate the efficiency of healing.

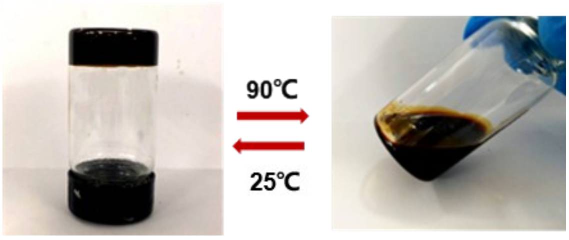

Fig. S4 Optical images of the magnetic gel undergoing phase transition at different temperatures.

At high temperatures, the solid gel transitions to the liquid. When the temperature drops to 25 °C, the fluid state changes to gel state.

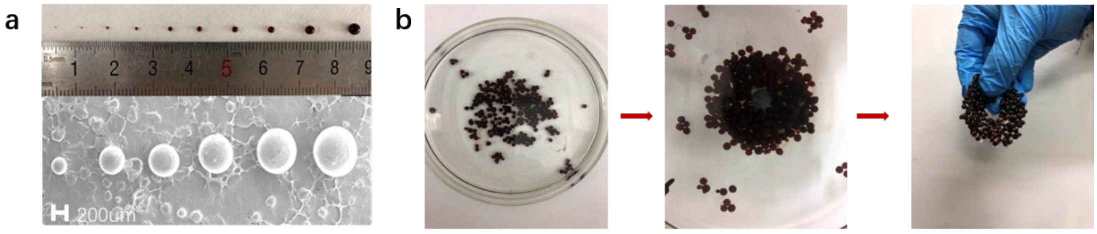

Fig. S5. (a) Optical image and SEM image of magnetic gel particles. (b) Optical images showing magnetic performance of the gel particles.

Gel particles of different sizes are prepared by needle extrusion. Under the action of the magnet, these magnetic gel particles automatically form the same pattern as the magnet. After 5 minutes, the gel particles healed into a whole.