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

Supporting Information

Highly stable and air-resistant photonic upconversion organogels with self-healing and temperature responsiveness

Xiaoyu Liu,[ab] Qin He,[a] Jiageng Pan,[a] Hui Liang,[a] Noreen Rehmat,[a] Liang Gao,*[a] Yanping Huo,[ab] and Shaomin Ji *[ab]

a. School of Chemical Engineering and Light Industry, Guangdong University of Technology, Guangzhou, 510006, China

b. Jieyang Branch of Chemistry and Chemical Engineering Guangdong Laboratory, Jieyang, 515200, China

E-mail: (smji@gdut.edu.cn, gaoliang@gdut.edu.cn)

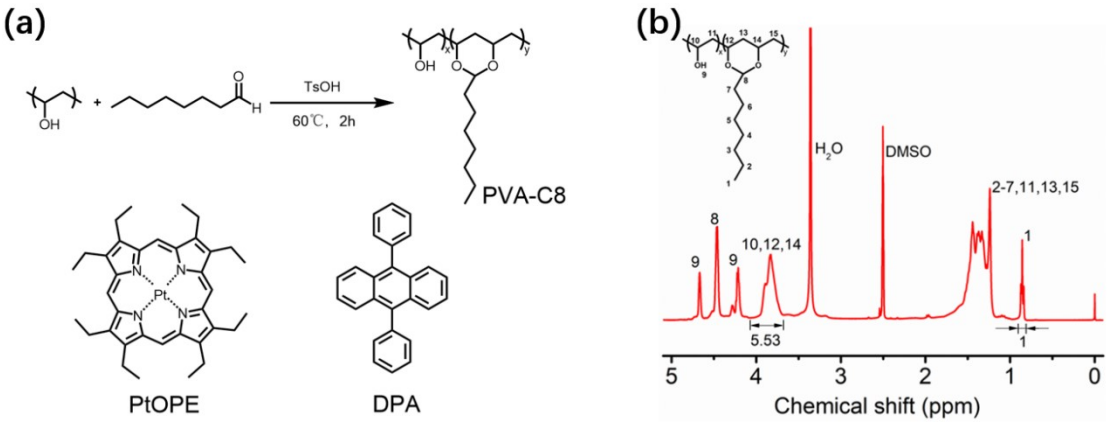

Fig. S1 (a) The synthesis method of PVA-C8, the upconverter used in the whole study. PtOEP is a photosensitizer, and DPA is an annihilator. (B) The NMR spectrum of PVA-C8 organogel. According to the peak area of the 1H NMR spectrum, the molar ratio of the octyl group to the initial hydroxyl group was calculated to determine the degree of reaction. No. 10, 12, and 14 H can represent the amount of -OH in all the initial PVA, and its integral area is set as S_2, and then according to No. 1 H being the same proton composition of the three chemical environments in

the methyl group, its integral area is set as S_1, and each side chain group should replace two -OH on the main chain. Therefore, according to the equation (S_1 / 3) *2 / S_2 = degree of substitution. The optimal degree of substitution is about 12±1% after pre-condition optimization and screening.

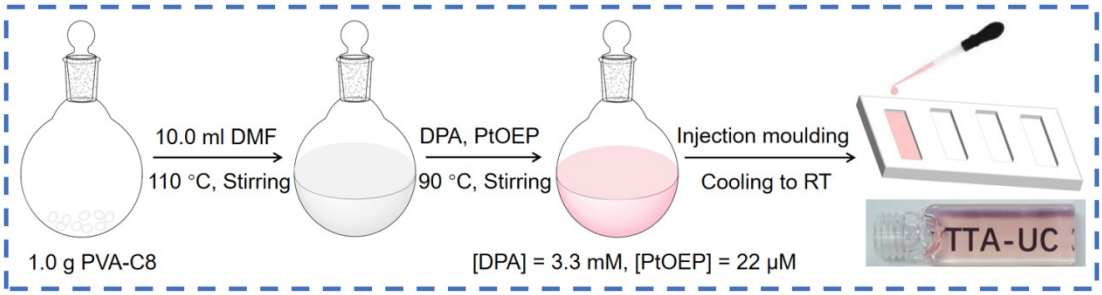

Fig. S2 Upconversion organogel preparation method and the amount of medicine in each step. The PVA-C8-PtOE-DPA organogel was injected into teflon molds and cuvettes for further characterization, and it can be seen that it has high transparency.

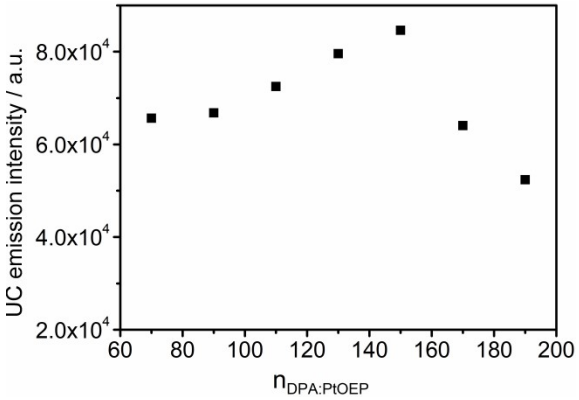

Fig. S3 In the PVA-C8 organogel, the influence of the molar ratio of PtOEP and DPA on the upconversion intensity, the optimal ratio is 1 : 150, that is, the chromophore concentration is [DPA] = 3.3 mM and [PtOEP] = 22 μM.

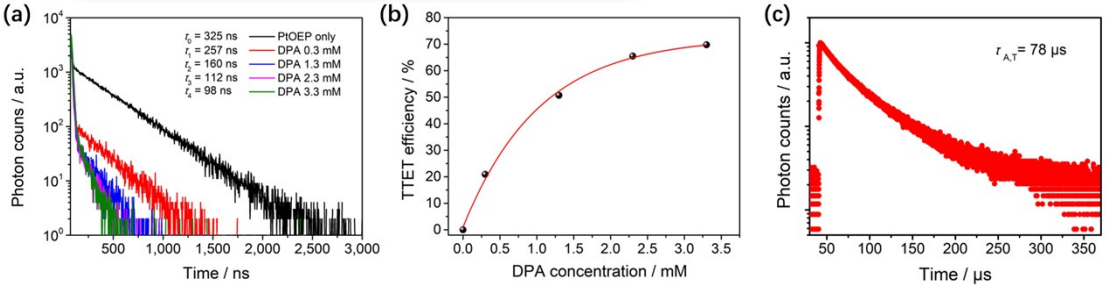

Fig. S4 Quenching of PtOEP phosphorescence (λ_{em} = 635 nm) (a)The luminescence lifetime of the photosensitizer in the organogels with and without triplet acceptor, under excitation at 532 nm ([PtOEP] = 2.2 μM, [DPA] = 0~3.3 mM), (b) TTET efficiency of the PtOEP /DPA pair in organogel, which was calculated according to equation 1, (c) the upconversion luminescence lifetime at 434 nm of PVA-C8-DPA-PtOEP organogel. All measurement were conducted under air conditions.

$$\Phi_{TTET} = 1 - \frac{\tau}{\tau_0} \qquad equation\ 1$$

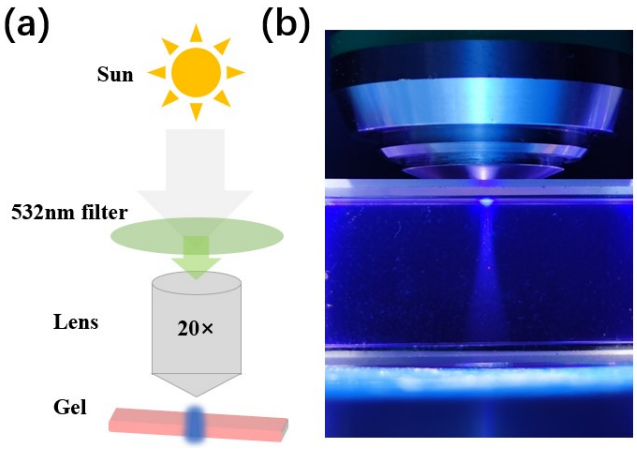

Fig. S5 Through filtering and focusing the sunlight, the upconversion emission is realized in the air state, (a) the schematic diagram of the device and operation, (b) the PVA-C8-DPA-PtOEP organogel in the cuvette is focused by the lens, upconversion is realized under sunlight, and the sunlight intensity is 100 mW/cm^2.

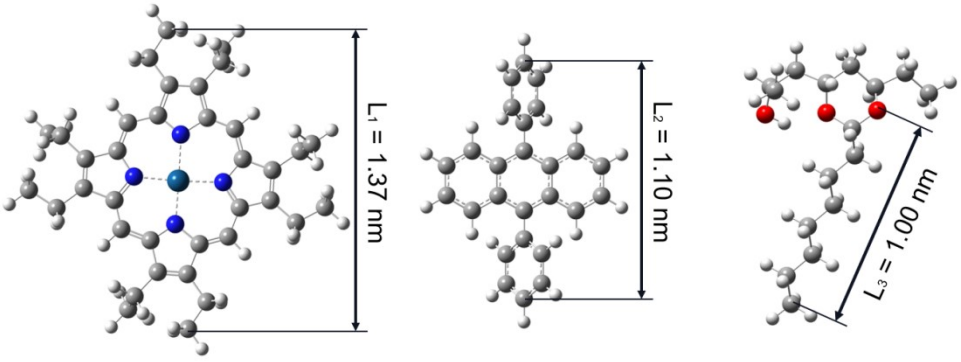

Fig. S6 the optimized structure of PtOEP, DPA and PVA-C8 model molecule (Software: G09; Solvation: DMF). According to the optimized structure, the longest distance between PtOEP molecules is L_1 = 1.37 nm, the longest distance between DPA molecules is L_2 = 1.10 nm, and the average length of attached octyl side chains is L_3 = 1.00 nm.

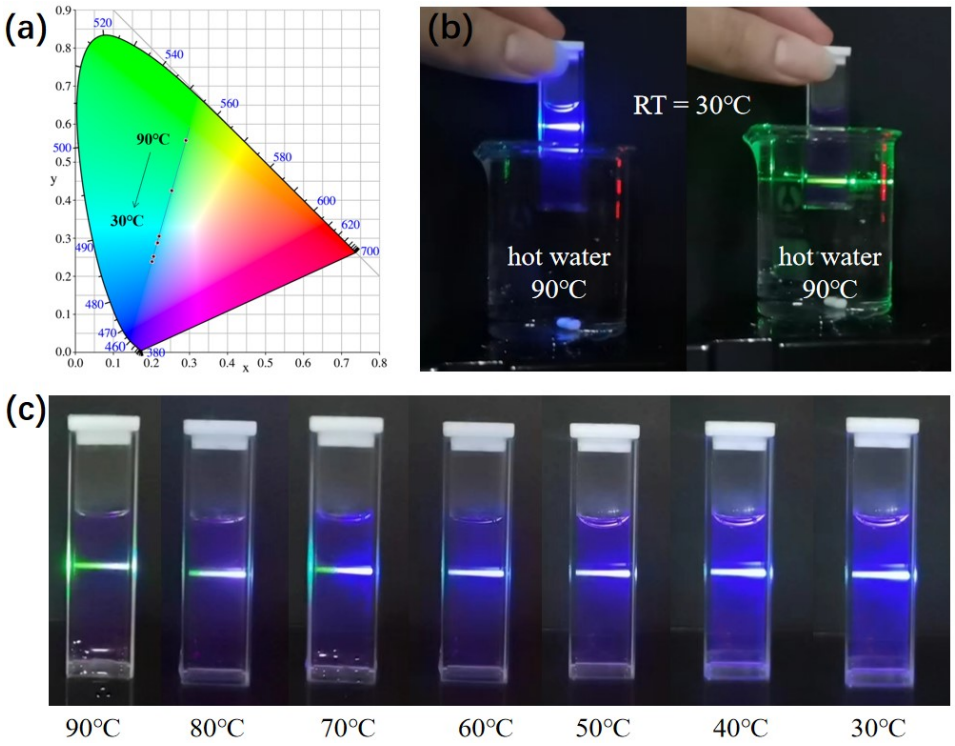

Fig. S7 (a) The CIE chromaticityl diagram of PVA-C8-DPA-PtOEP organogel, light color change from 90-30 ℃. (b) At 30 ℃ and 90 ℃, the upconversion organogels showing blue and green light, respectively. (c) Shows the change of the luminescence color of the gel from green to blue with the temperature change at 90-30 ℃.

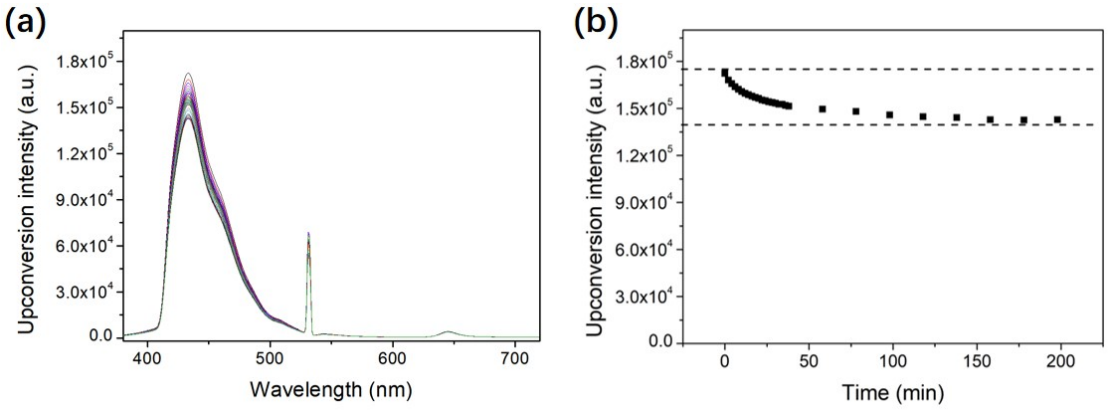

Fig. S8 (a) Under the condition of continuous 198 min excitation intensity of 500 mW·cm^{-2} with a 532nm laser in the air, the up-conversion emission spectrum of PVA-C8-PtOEP-DPA (b) at

434nm, the corresponding Up-conversion emission intensity (stability) over time.

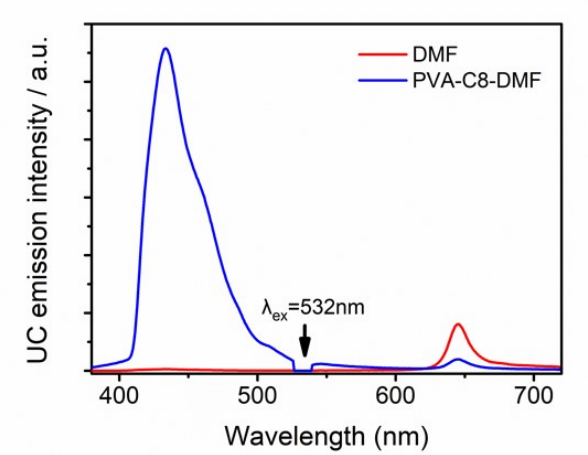

Fig. S9 The emission spectra of PVA-C8-DPA-PtOEP organogel (blue line) and DMF-DPA-PtOEP solution (red line) under the same excitation intensity of 532 nm in air ([PtOEP] = 22 μM, [DPA] = 3.3 mM).

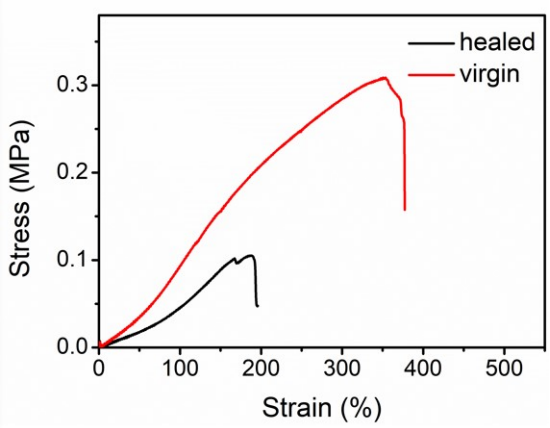

Fig. S10 The stretch curve (red line) of PVA-C8-DPA-PtOEP organogel and the stretch curve (black line) of the gel that was partially heated at 90 °C to assist healing after shearing.

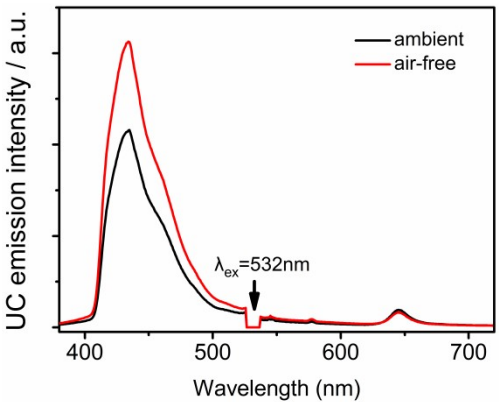

Fig. S11 The photoluminescence spectra of PVA-C8-DPA-PtOEP organogel under deoxygenation (red line) and air (black line) under 532nm laser excitation.