Electronic Supplementary Material (ESI) for Soft Matter.

Heteropoly acids triggered self-assembly of cationic peptides into photo- and electro-chromic gels

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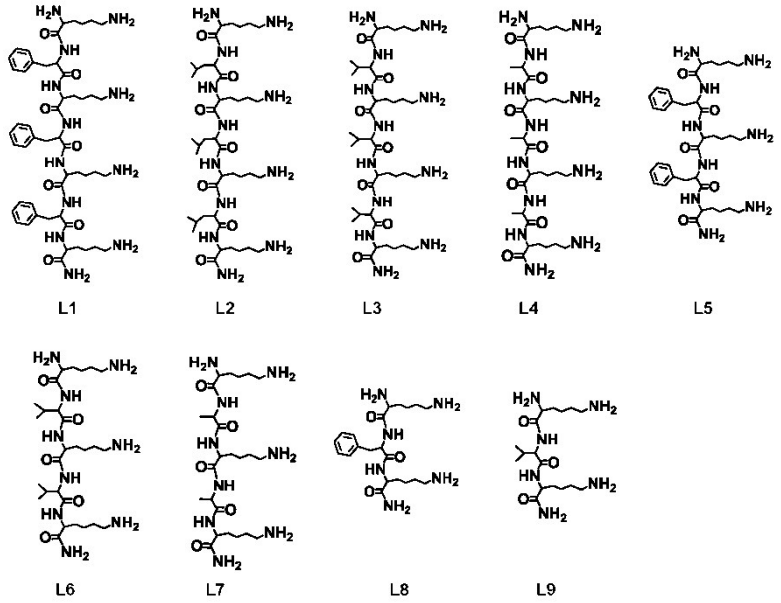
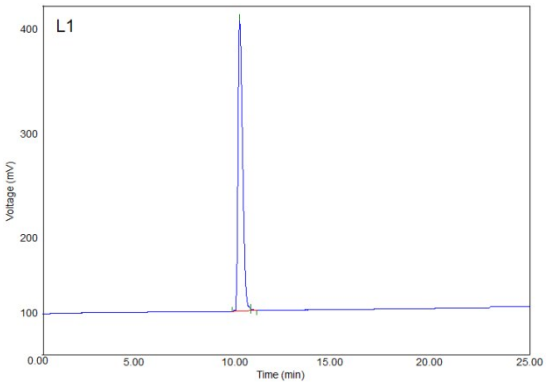
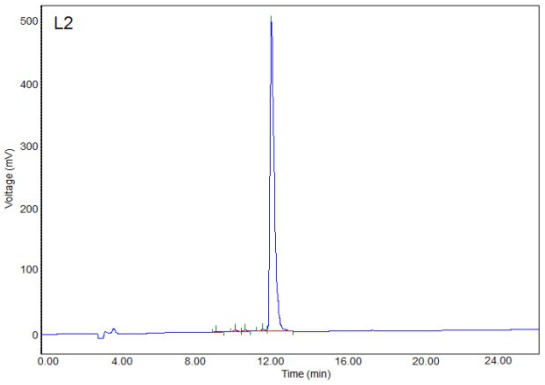
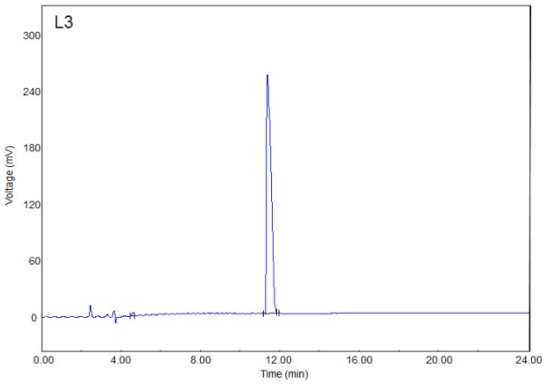
Supplementary Information

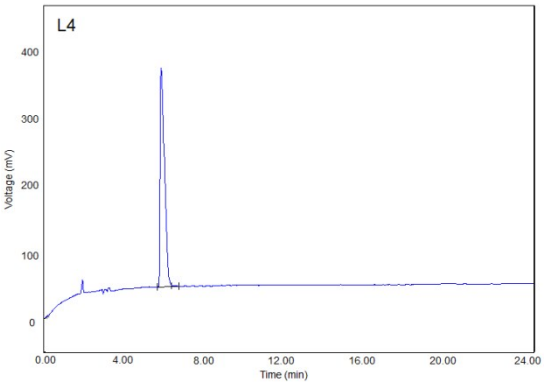


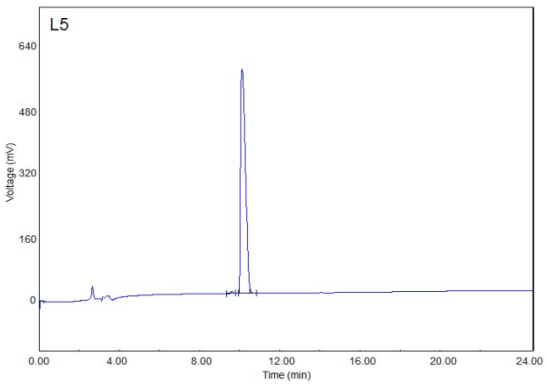
Scheme S1. The schematic structures of the designed peptides (L1-L9).

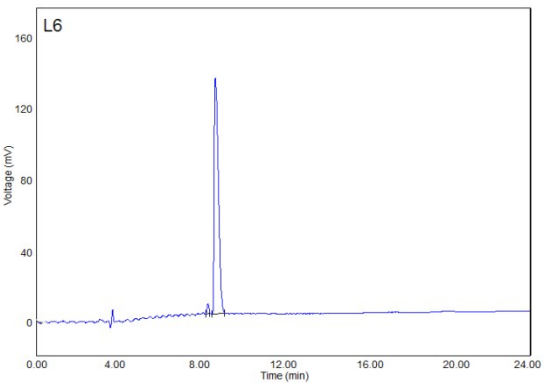

L1
Voltage (mV)
Time (min)

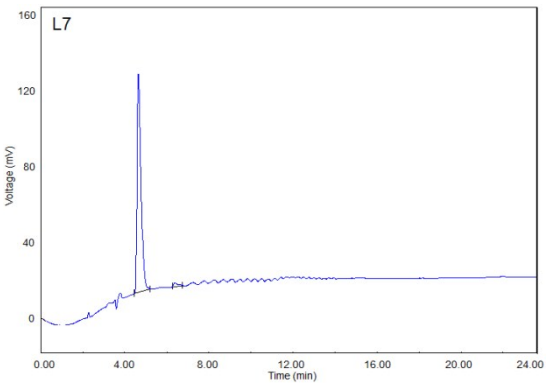

L2
Voltage (mV)
Time (min)

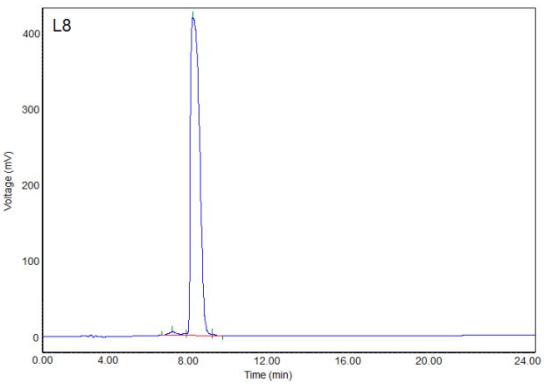

L3
Voltage (mV)
Time (min)


L4
Voltage (mV)
Time (min)


L5
Voltage (mV)
Time (min)


L6
Voltage (mV)
Time (min)


L7
Voltage (mV)
Time (min)


L8
Voltage (mV)
Time (min)

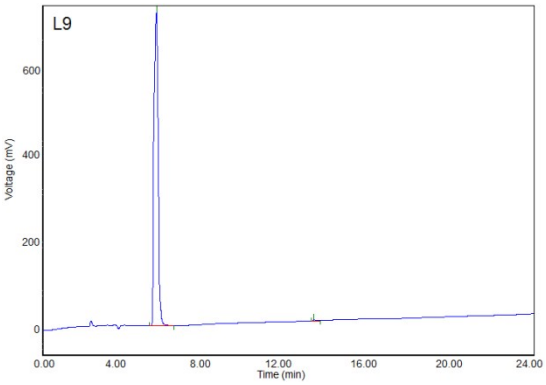
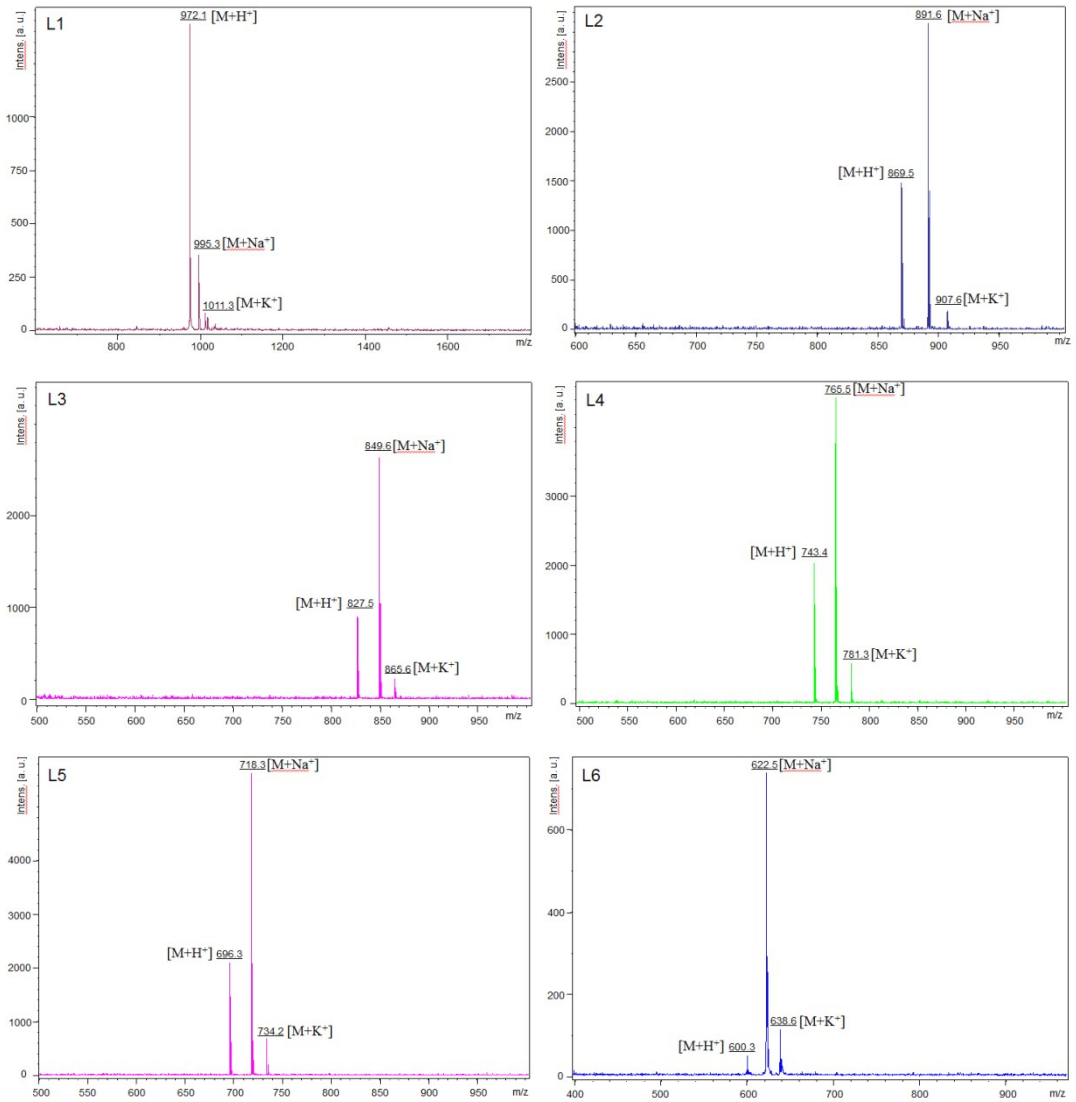


Figure S1. HPLC curves of the synthesized peptides.



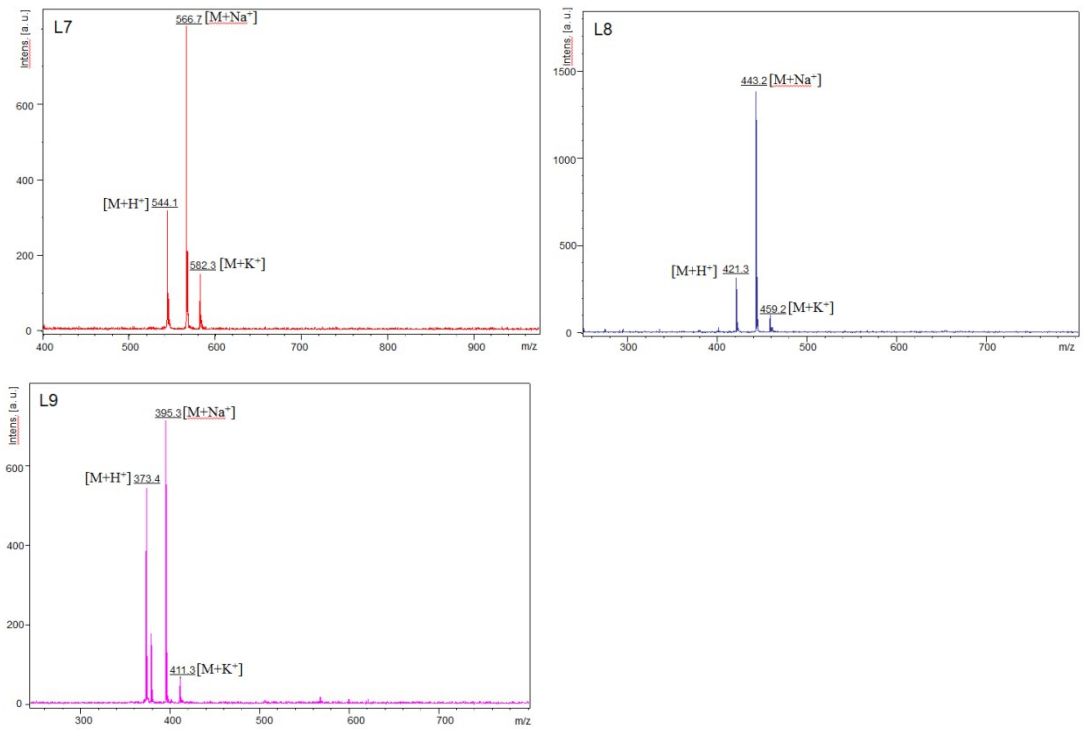


Figure S2. MALDI-TOF-MS spectra of the synthesized peptides.

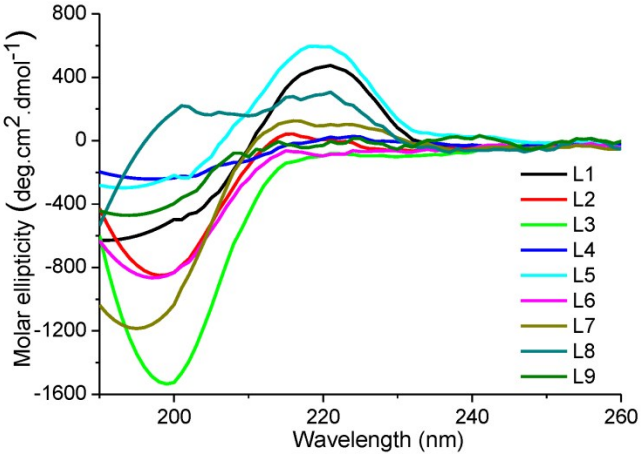


Figure S3.The circular dichroism (CD) spectra of the peptides in aqueous solution (pH ~ 5.7).

Table S1. Gelation behavior of L1/HSiW in mixed solvent with different volume ratio (n) of water to ethanol. (It should be noted that the final weight amount of L1 and HSiW was fixed at 3.24 mg and 9.61 mg, respectively, and the final volume of the water/ethanol mixed solution was kept at 240 uL.)

Sample	n	state
L1/HSiW	30:1	G
	25:1	G
	20:1	G
	15:1	G
	10:1	G
	5:1	G
	3:1	UG
	1:1	P

P=precipitate, G=gel, UG=unstable gel.

Table S2. Gelation behavior of L1/HSiW in mixed solvent with different initial concentration. (It should be noted that the volume ratio of water to ethanol was fixed at 5:1, and the final volume of the water/ethanol mixed solution was kept at 240 uL)

Sample	initial concentration of L1 (mg/mL)	initial concentration of HSiW (mg/mL)	State

L1/HSiW	**16.2**	80.1	P
	16.2	120.2	P
	16.2	240.3	G
	16.2	480.6	UG
	32.4	**240.3**	G
	16.2	**240.3**	G
	8.1	**240.3**	P

Table S3. Gelation behavior of L1/HSiW in different solvents. (It should be noted that the final weight amount of L1 and HSiW in the mixed solutions were kept at 3.24 mg and 9.61 mg, respectively, the volume ratio of water to organic solvent was fixed at 5:1, and the final volume of the water/organic solvent mixed solution was kept at 240 uL)

Sample	Solvent	State
L1/HSiW	H_2O	P
	H_2O/DMF	P
	H_2O/CH_3CN	P
	H_2O/THF	P
	H_2O/Dioxane	P
	H_2O/CH_3OH	P
	H_2O/DMSO	UG
	H_2O/Acetone	UG

P=precipitate, UG=unstable gel.

Table S4. Gelation behavior of L1/HSiW in different solvents with varying proportions ($V_{water}/V_{organic\ solvent}$ = n). (It should be noted that the final weight amount of L1 and HSiW in the mixed solutions were kept at

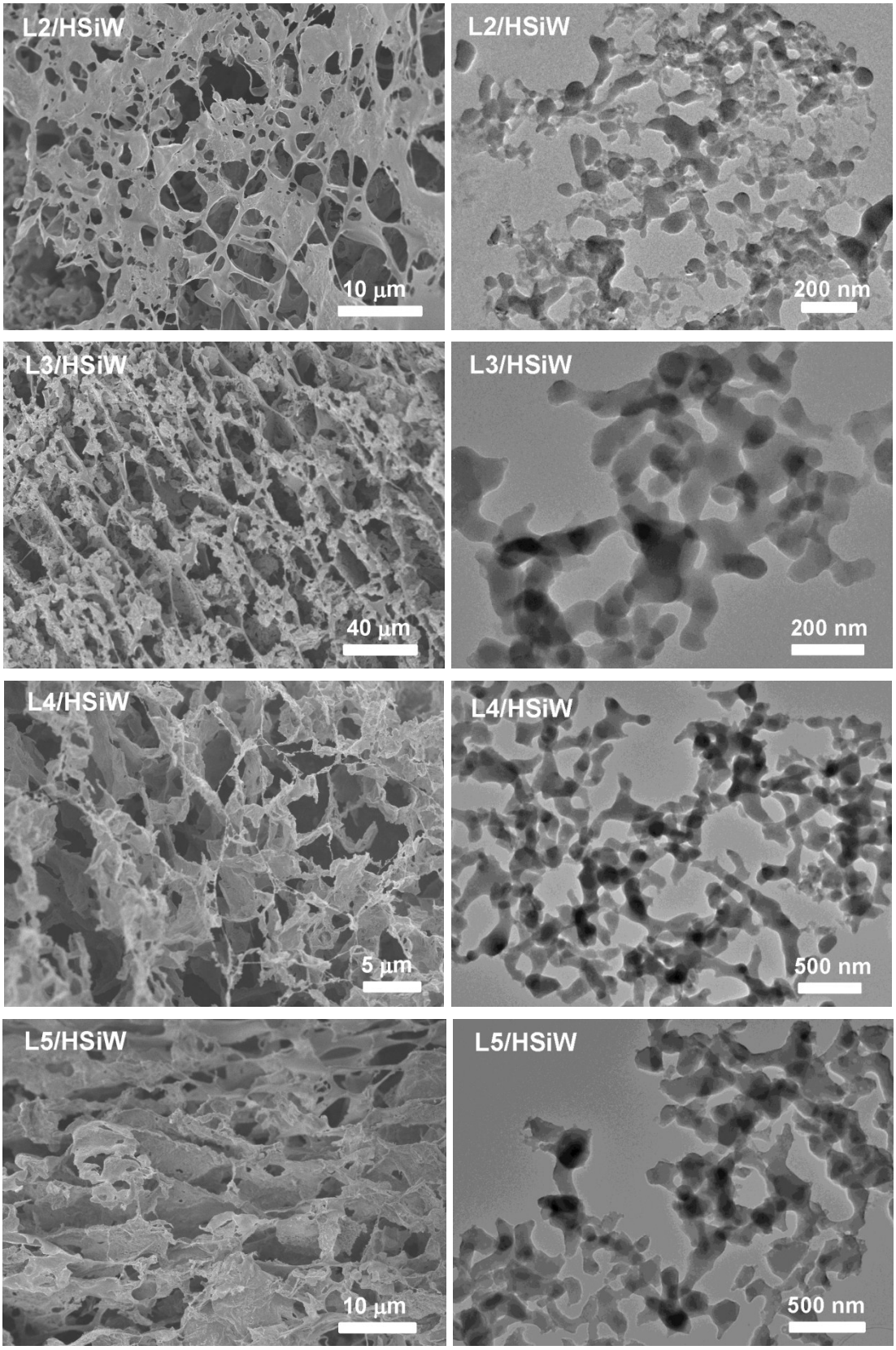
3.24 mg and 9.61 mg, respectively, the molar ratio of L1 to HSiW was fixed at 1:1, and the final volume of the water/organic solvent mixed solution was kept at 240 uL)

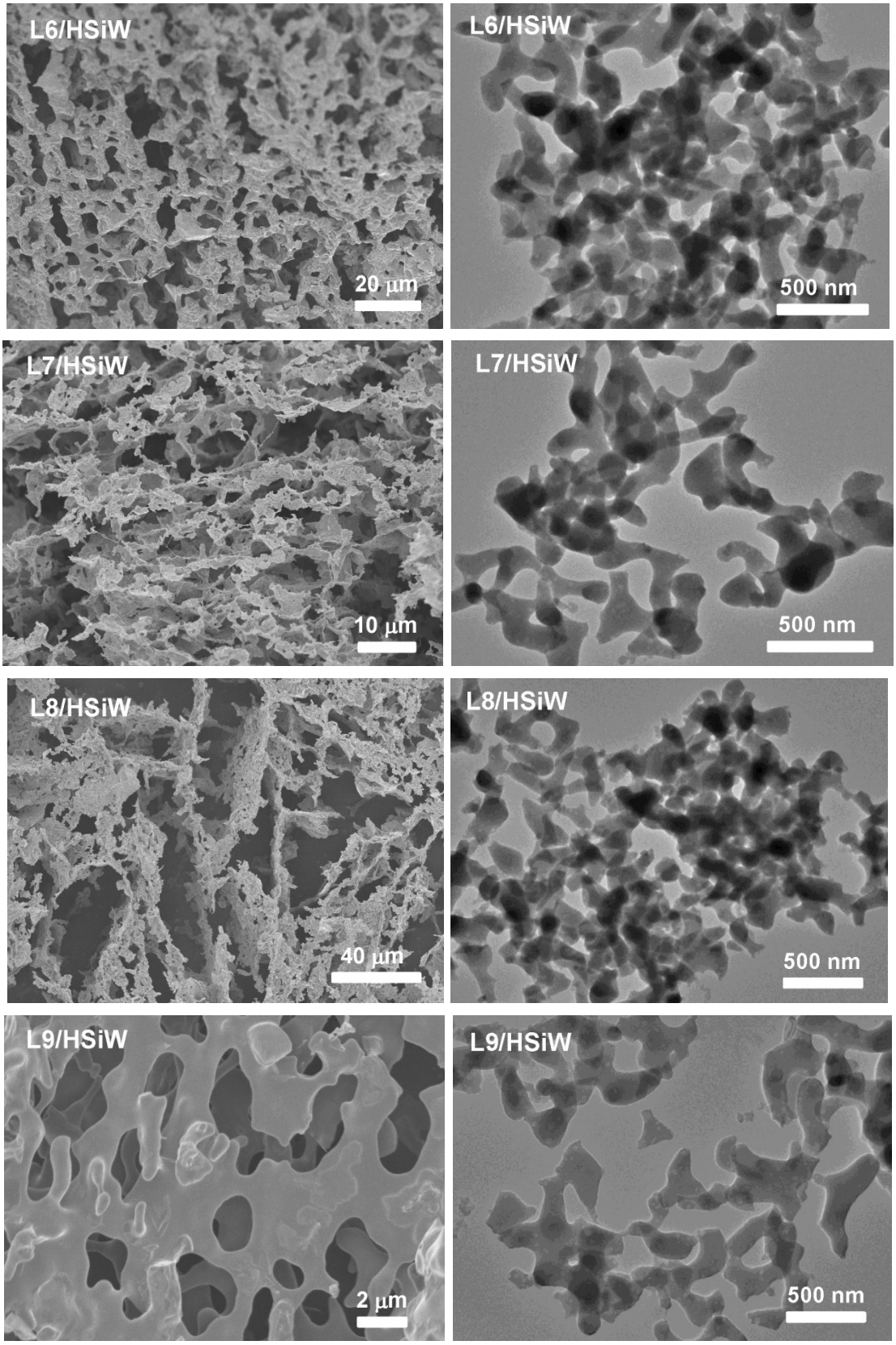
Sample	Solvent	n	State
L1/HSiW	H_2O/DMSO	1:1	S
		2:1	P
		3:1	P
		5:1	UG
		10:1	UG
	H_2O/Acetone	5:1	UG
		10:1	UG
		15:1	UG
		20:1	UG

P=precipitate, S=solution, UG=unstable gel.

Table S5. Estimated β-sheet content from the Gaussian curve fitting of amid I spectra of the freeze-dried gel samples.

Sample	β-sheet	random coil
L1/HSiW	55.3%	45.7%
L2/HSiW	51.3%	48.7%
L3/HSiW	45.4%	54.5%
L4/HSiW	36.4%	63.6%
L5/HSiW	46.7%	53.3%
L6/HSiW	46.5%	53.5%
L7/HSiW	46.3%	53.7%
L8/HSiW	45.9%	54.1%
L9/HSiW	45.0%	55.0%


L2/HSiW
10 μm
L2/HSiW
200 nm
L3/HSiW
40 μm
L3/HSiW
200 nm
L4/HSiW
5 μm
L4/HSiW
500 nm
L5/HSiW
10 μm
L5/HSiW
500 nm


L6/HSiW
20 μm
L6/HSiW
500 nm
L7/HSiW
10 μm
L7/HSiW
500 nm
L8/HSiW
40 μm
L8/HSiW
500 nm
L9/HSiW
2 μm
L9/HSiW
500 nm

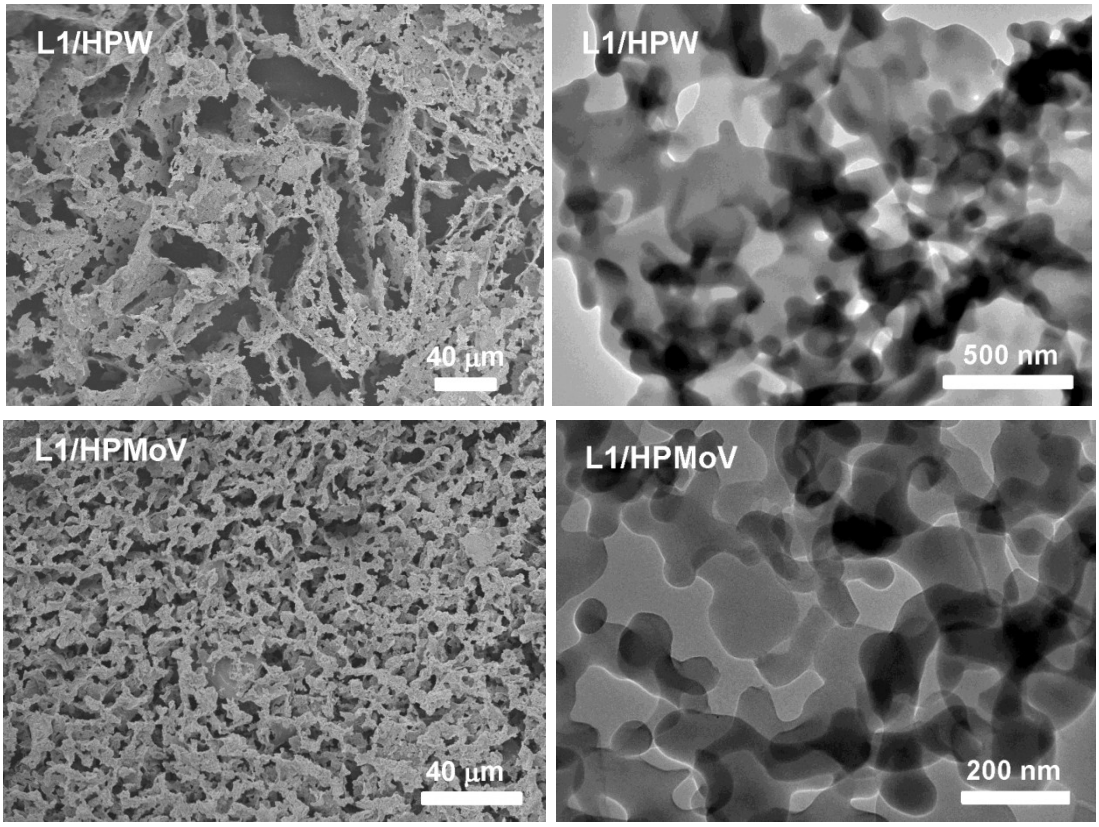
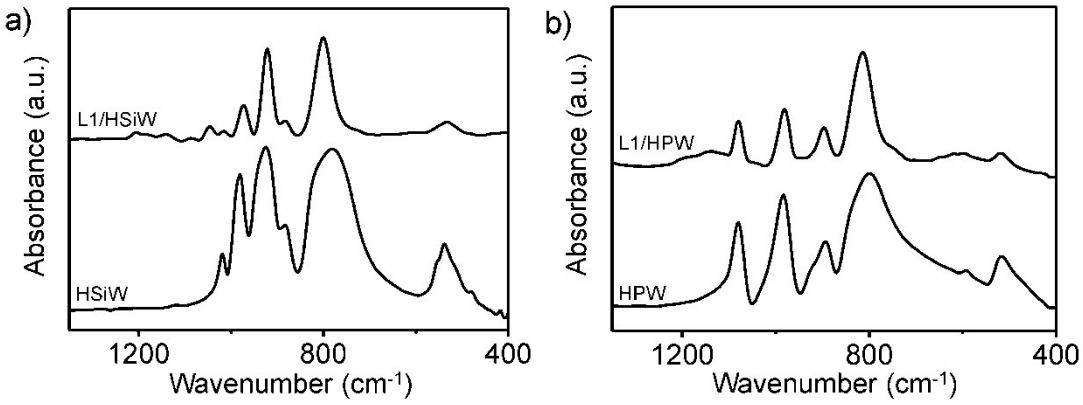


Figure S4. SEM images (left column) of the freeze-dried gel samples and TEM images (right column) of the diluted hybrid gels in water/ethanol (v/v = 5/1) mixed solution.



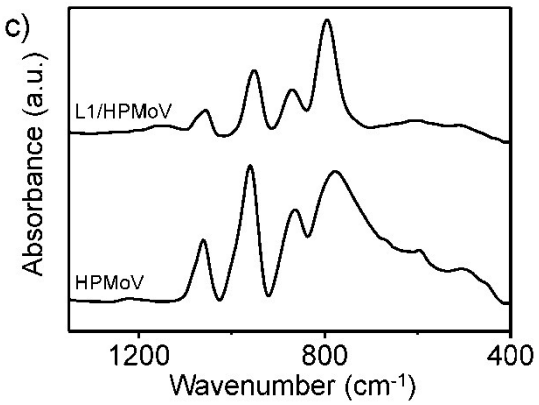


Figure S5. FT-IR spectra of the HPAs and the corresponding L1/HPAs hybrid gels in the range of 1350-400 cm^{-1}: (a) HSiW and L1/HSiW gel; (b) HPW and L1/HPW gel; (c) HPMoV and L1/HPMoV gel.

(Individual HSiW shows typical absorption bands at 982, 882 and 780 cm^{-1}, which were assigned to the ν_{as} (W=O_d), ν_{as} (W-O_b-W) and ν_{as} (W-O_c-W), respectively. In the case of dried gel samples of HSiW, the corresponding vibration modes slightly shift to 971, 882 and 798 cm^{-1}, respectively. The bands of HPW at 983, 893 and 798 cm^{-1} correspond to ν_{as} (W=O_d), ν_{as} (W-O_b-W) and ν_{as} (W-O_c-W), respectively. In the case of L1/HPW, the vibration modes slightly shift to 981, 897 and 814 cm^{-1}, respectively. The absorption bands of HPMoV at 960, 863 and 778 cm^{-1} correspond to ν_{as} (Mo=O_d), ν_{as} (Mo-O_b-Mo) and ν_{as} (Mo-O_c-Mo), respectively. In the case of L1/HPMoV, the stretching vibration modes slightly shift to 951, 867 and 793 cm^{-1}, respectively. The above results suggest that the topology structures of HPAs are intact during the gelation process.

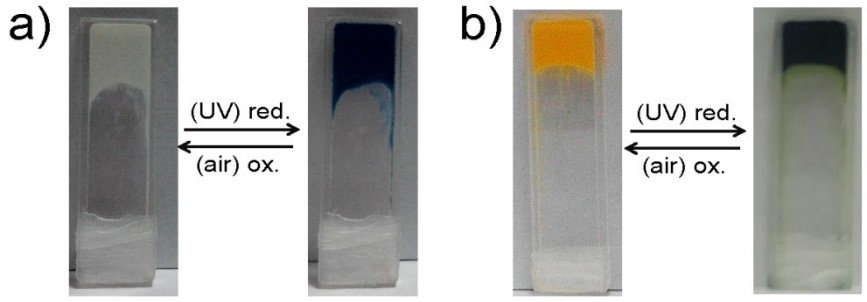


Figure S6. Photochromic behavior of L1/HPW and L1/HPMoV gels with alternate exposure to UV and air.

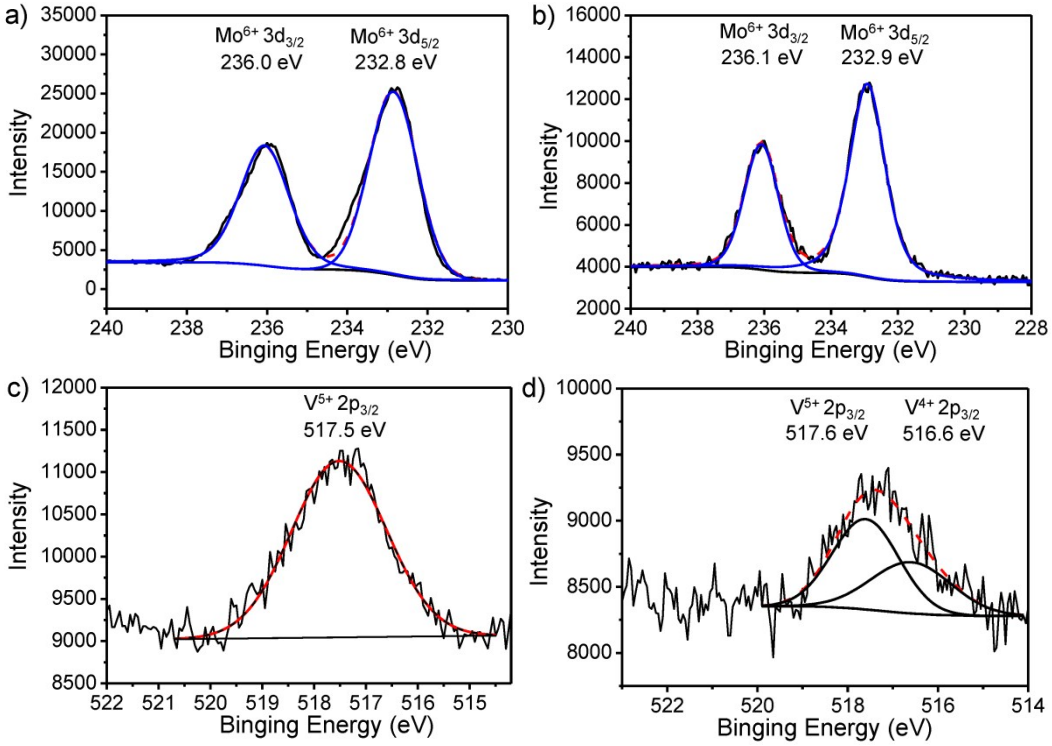


Figure S7. XPS spectra of L1/ HPMoV hybrid gel before (a, c) and after (b, d) UV irradiation: Mo 3d level (a, b); V 2p level (c, d).