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Supporting Information

Chitosan-based double cross-linked ionic hydrogels as a strain and pressure sensor with broad strain-range and high sensitivity

Xuemei Li, Zhiwei Liu, Yongri Liang*, L-Min Wang and Ying Dan Liu*

State Key Lab of Metastable Materials Science and Technology, and College of Materials Science and Engineering, Yanshan University, Qinhuangdao 066004, P.R. China

Email: liangyr@ysu.edu.cn (Y. L.); ydliu@ysu.edu.cn (Y.D.L.)

Cytotoxicity Tests of the P(AAm-co-AA)/CS-Fe^{3+} Hydrogel

NIH3T3 cells (mouse embryonic fibroblasts) (iCell Bioscience Inc) were used for the cytotoxicity assay. The growth media (Dulbecco's modified eagle medium, DMEM, Coring) was supplemented with 10% Fetal Bovine Serum (FBS) (Shanghai yuanye Bio-Technology Co., Ltd), 1% sodium pyruvate (Geno Biomedical Technology Co., Ltd) and 1% glutamine (Geno Biomedical Technology Co., Ltd). NIH3T3 cells were seeded on the 96-well plates (6000 cells/well) with the growth media (200 μL) in an incubator (5% CO_2, 37 °C). After 24 h, a certain amount of P(AAm-co-AA)/CS-Fe^{3+} hydrogel (0.99 mg) was added. After being incubated with the hydrogel, the cell viability was measured by CCK-8 assay. Typically, 100 μL of CCK-8 solution (Invigentech) was added to each well of the plates. NIH3T3 cells were incubated for another 2 h. Afterward, the media were transferred into another 96-well plate to measure the absorbance at 450 nm by using a microplate reader.

Antimicrobial Tests of the P(AAm-co-AA)/CS-Fe^{3+} Hydrogel

Escherichia coli (ATCC25922, *E. coli*), *Staphylococcus aureus* (ATCC25923, *S. aureus*) and *Pseudomonas aeruginosa* (CMCC(B)10104, *P. aeruginosa*) were used to test the antibacterial activity of the P(AAm-co-AA)/CS-Fe^{3+} hydrogel *via* an inhibition zone method. The three kinds of bacteria were activated in the Luria−Bertani (LB) broth (37 °C, 180 rpm) for 24 h. Then the concentration of the bacteria suspensions was adjusted to 10^7 CFU/mL. 90 μL of each suspension was seeded to the plates of LB culture medium. The hydrogel samples with a regular size (cylinder shape with a diameter of 6 mm) were exposed to the three kinds of bacteria suspension on the plates respectively. All samples were incubated (37 °C, 180 rpm) for 24 h, and then the inhibition zone was observed and measured. In addition, drug sensitive paper and 0.9 %g/L NaCl were used as positive control and negative control respectively.

Table S1. The dosage of each reagent used in the fabrication process of hydrogels.

Sample	Mass of reagents (g)				
	CS	AA	AAm	Irgacure 2959	H_2O
P(AAm-co-AA)	0	0.144	1.42	0.025	10
P(AAm-co-AA)/CS	0.2	0.144	1.42	0.025	10
P(AAm-co-AA)/CS-Fe^{3+}-1	0.2	0.086	1.42	0.025	10
P(AAm-co-AA)/CS-Fe^{3+}-2	0.2	0.115	1.42	0.025	10
P(AAm-co-AA)/CS-Fe^{3+}-3	0.2	0.144	1.42	0.025	10
P(AAm-co-AA)/CS-Fe^{3+}-4	0.2	0.172	1.42	0.025	10
P(AAm-co-AA)/CS-Fe^{3+}-5	0.1	0.144	1.42	0.025	10
P(AAm-co-AA)/CS-Fe^{3+}-6 [a]	0.2	0.144	1.42	0.025	10
P(AAm-co-AA)/CS-Fe^{3+}-7	0.3	0.144	1.42	0.025	10

[a] The sample for extensive mechanical and sensing performance study.

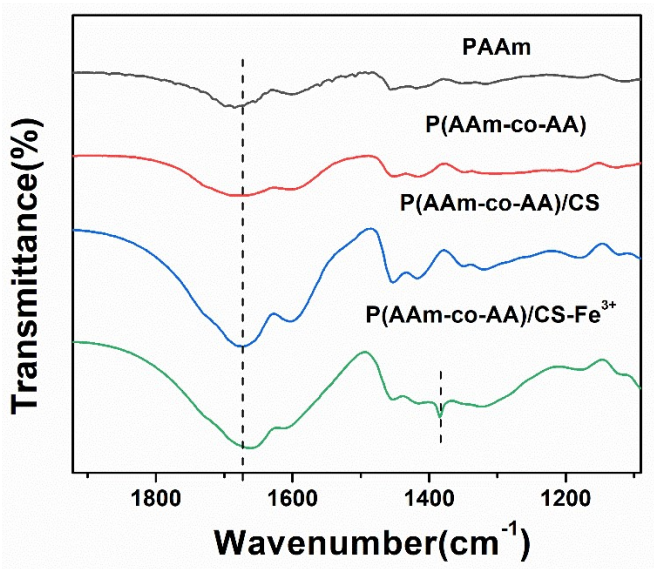

Figure S1. FTIR spectra of PAAm, P(AAm-co-AA), P(AAm-co-AA)/CS, and P(AAm-co-AA)/CS-Fe^{3+}.

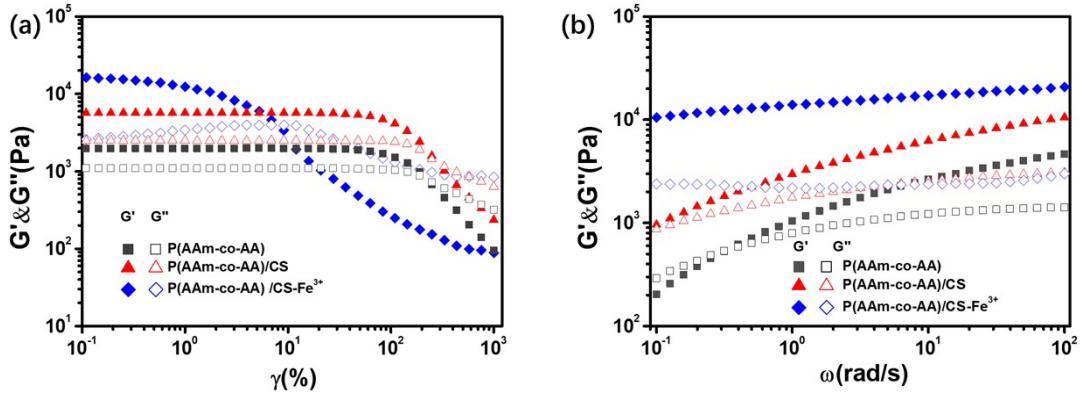

Figure S2. Storage modulus (G') and loss modulus (G") of P(AAm-co-AA), P(AAm-co-AA)/CS and P(AAm-co-AA)/CS-Fe^{3+} hydrogels in amlitude sweep (a) and frequency sweep (b) .

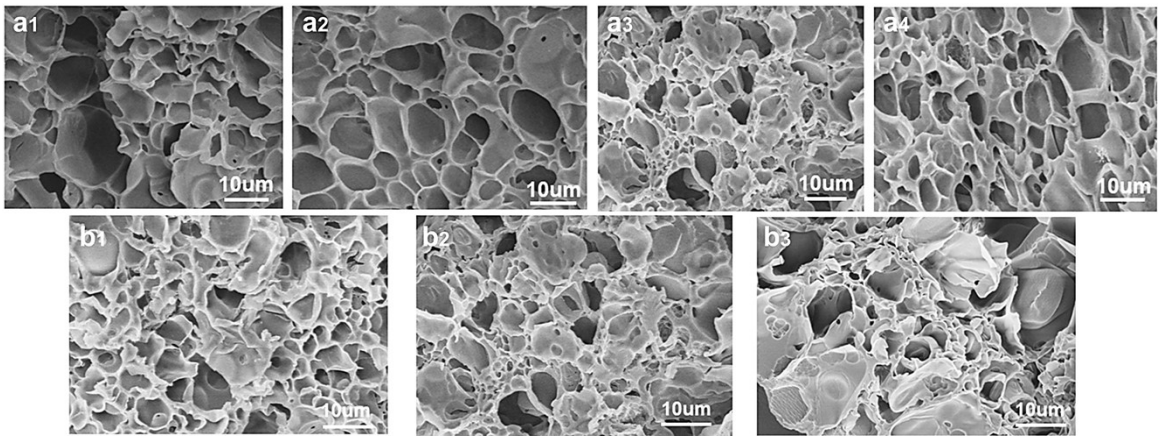

Figure S3. SEM images of the cross section of the P(AAm-co-AA)/CS-Fe^{3+} hydrogel with different molar ratios of AA/AAm (a1: 6 mol%, a2: 8 mol%, a3: 10 mol%, and a4: 12 mol%) and different CS contents (b1: 1 wt%, b2: 2 wt%, and b3: 3 wt%).

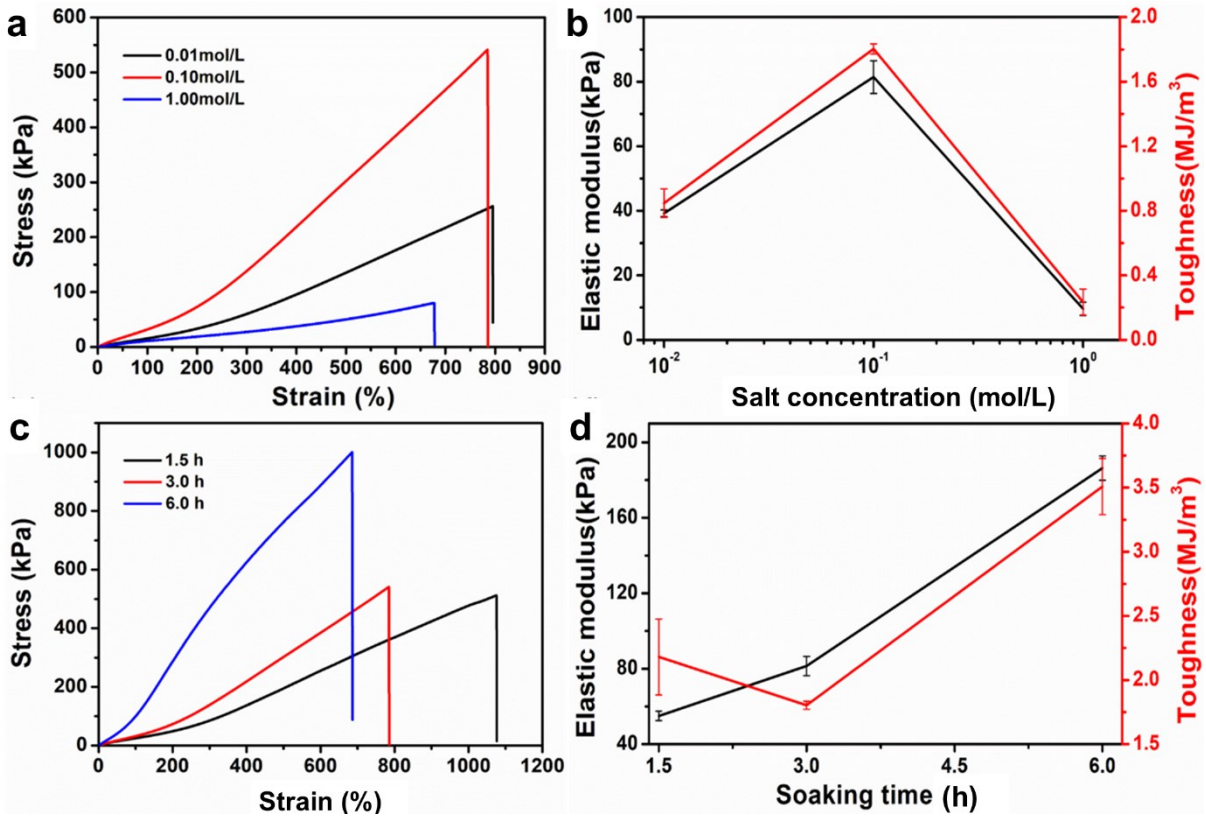

Figure S4. The stress-strain curves of the P(AAm-co-AA)/CS-Fe^{3+} hydrogel prepared by soaking in $Fe(NO_3)_3$ solution with different concentrations (a) and soaking times (c); elastic modulus and toughness of the hydrogels as a function of $Fe(NO_3)_3$ concentration (b) and soaking time (d)

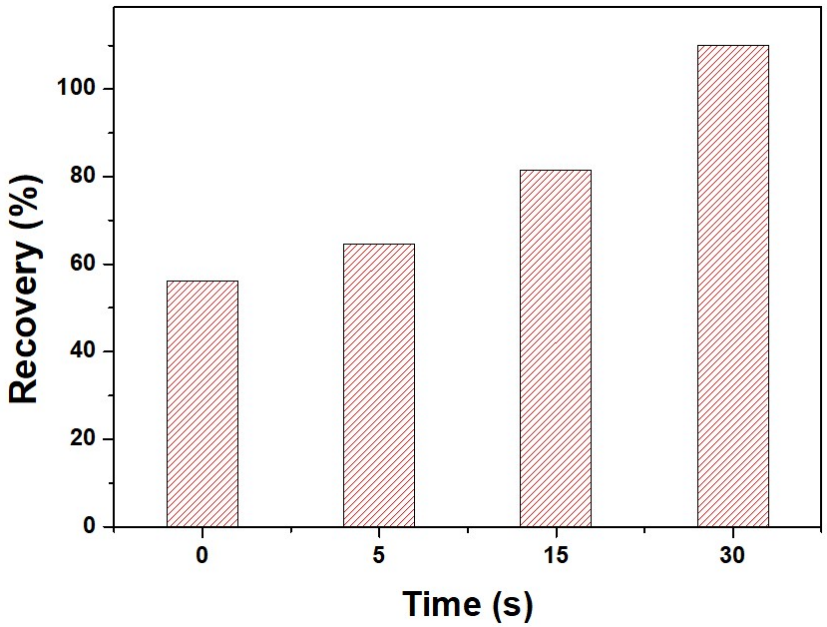

Figure S5. The recovery rate of the P(AAm-co-AA)/CS-Fe^{3+} hydrogel at different rest times in cyclic tensile tests.

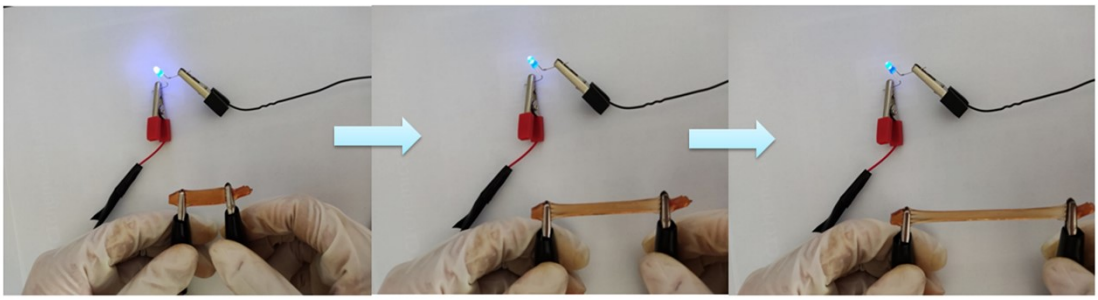

Figure S6. The LED brightness varies with different deformation.

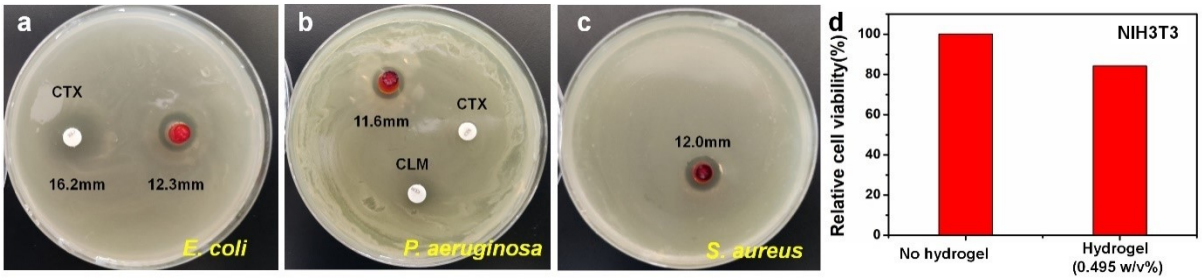

Figure S7. Antibacterial activity of the P(AAm-co-AA)/CS-Fe^{3+} hydrogel on E. coli (a), P. aeruginosa (b) and S. aureus (c) evaluated by an inhibition zone method and relative viability of NIH3T3 cells incubated with the P(AAm-co-AA)/CS-Fe^{3+} hydrogel by using a CCK-8 method. The red sample in a-c is the P(AAm-co-AA)/CS-Fe^{3+} hydrogel and the white disc is cefotaxime (CTX) or chloramphenicol (CLM) used as positive control.