Supporting Information

Tunable, conductive, self-healing, adhesive and injectable hydrogel for bioelectronics and tissue regeneration applications

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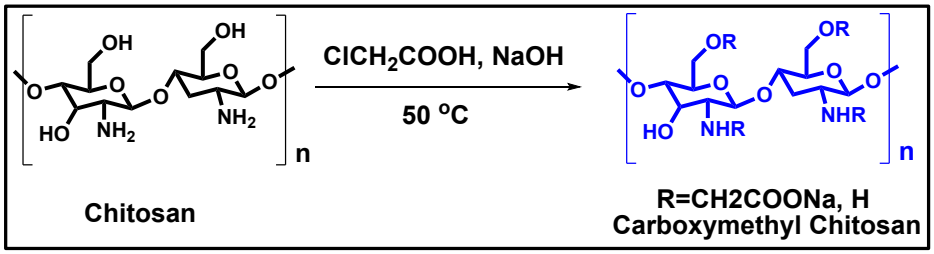

Figure S1. Scheme for the synthesis of carboxymethyl chitosan.

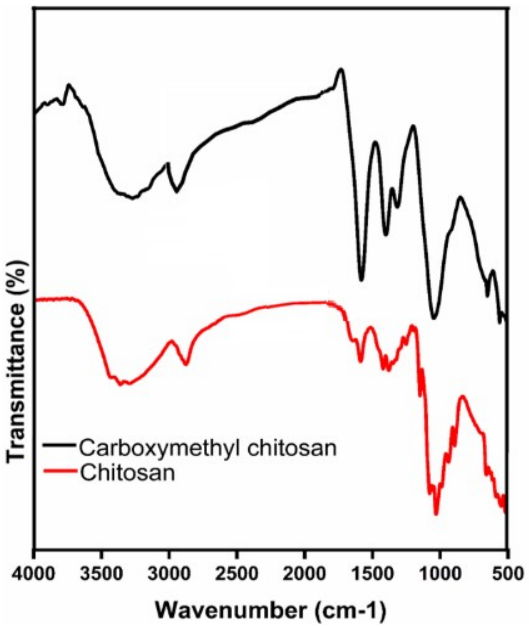

Figure S2. FTIR Spectra of chitosan and carboxymethyl chitosan

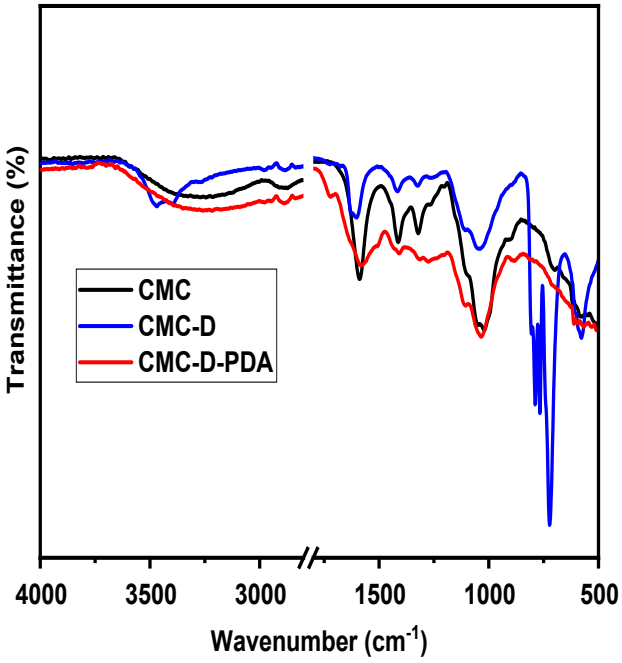

Figure S3. FTIR Spectra of CMC, CMC-D and CMC-D-PDA

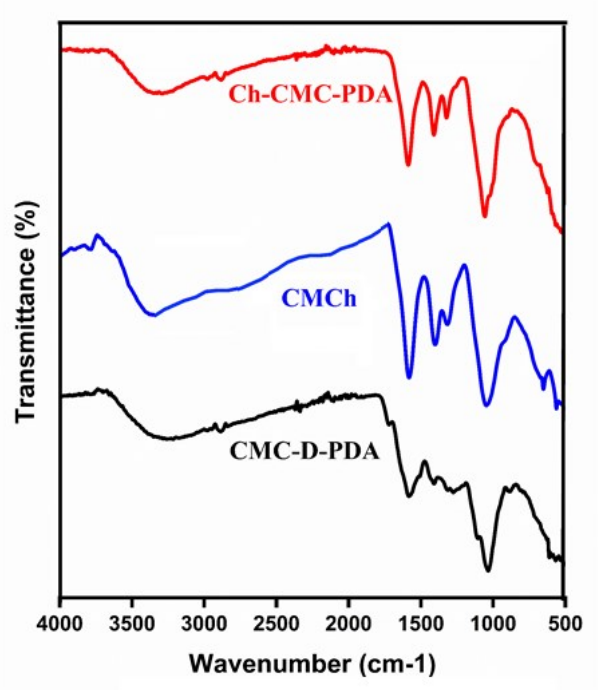

Figure S4. FTIR Spectra of CMC-D-PDA, CMCh and Ch-CMC-PDA

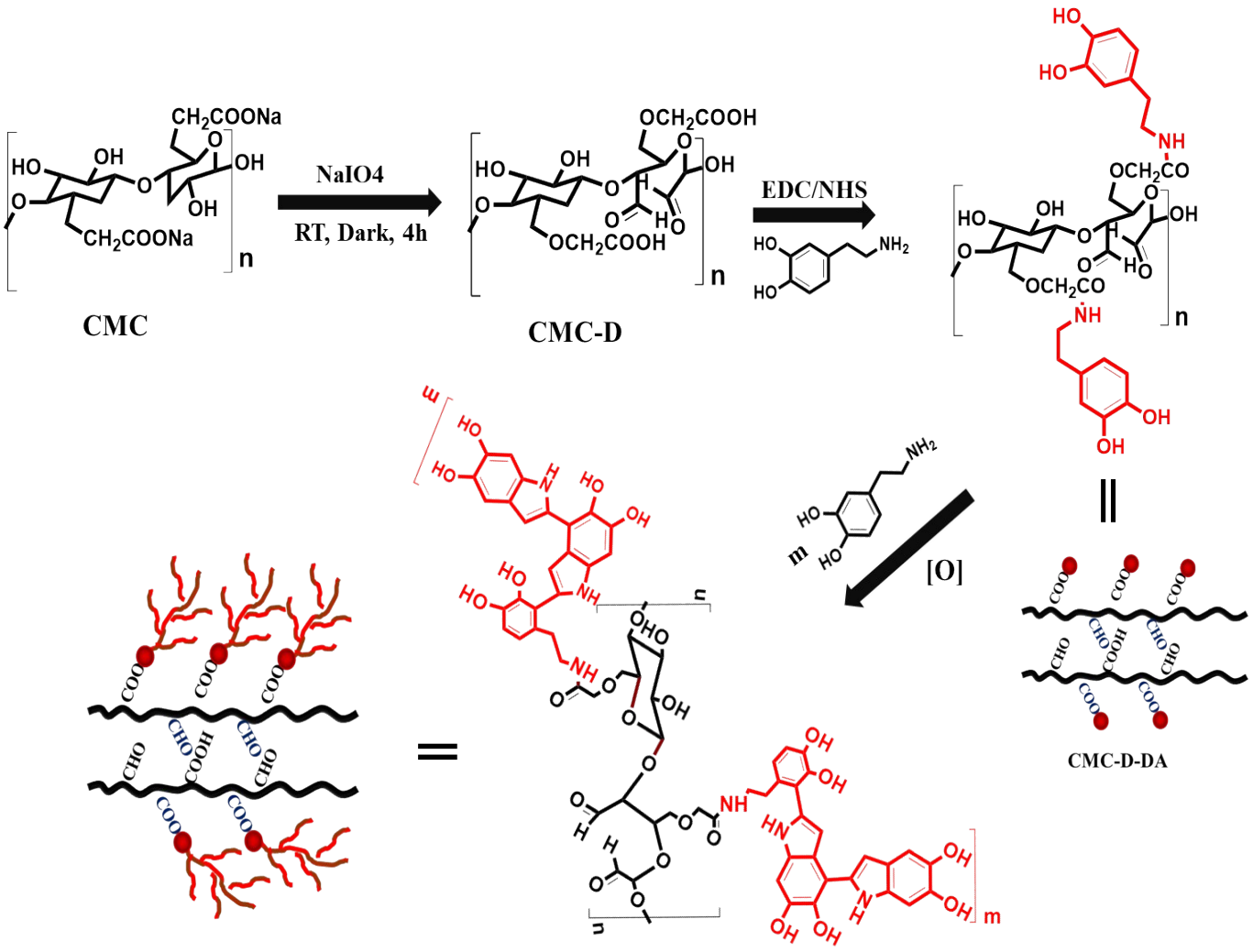

Figure S5. Scheme for the synthesis of Ch-CMC-PDA

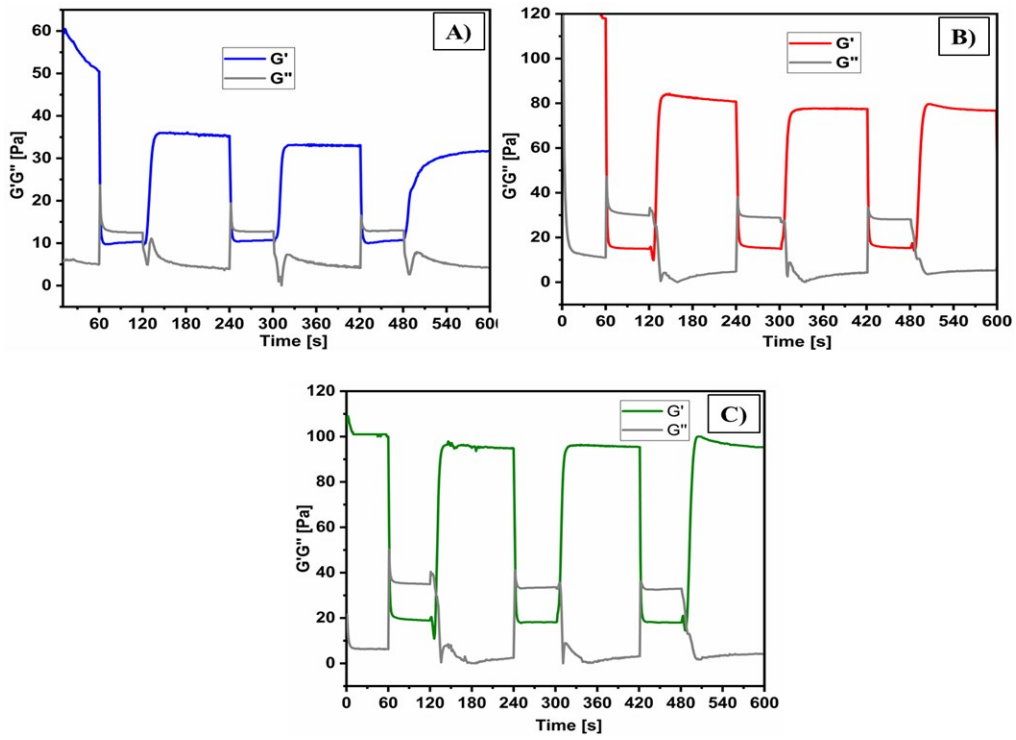

Figure S6. The recovery of hydrogel after high shear load demonstrated by the continuous step strain. A) Ch-CMC-PDA$_1$, B) Ch-CMC-PDA$_2$, C) Ch-CMC-PDA$_3$

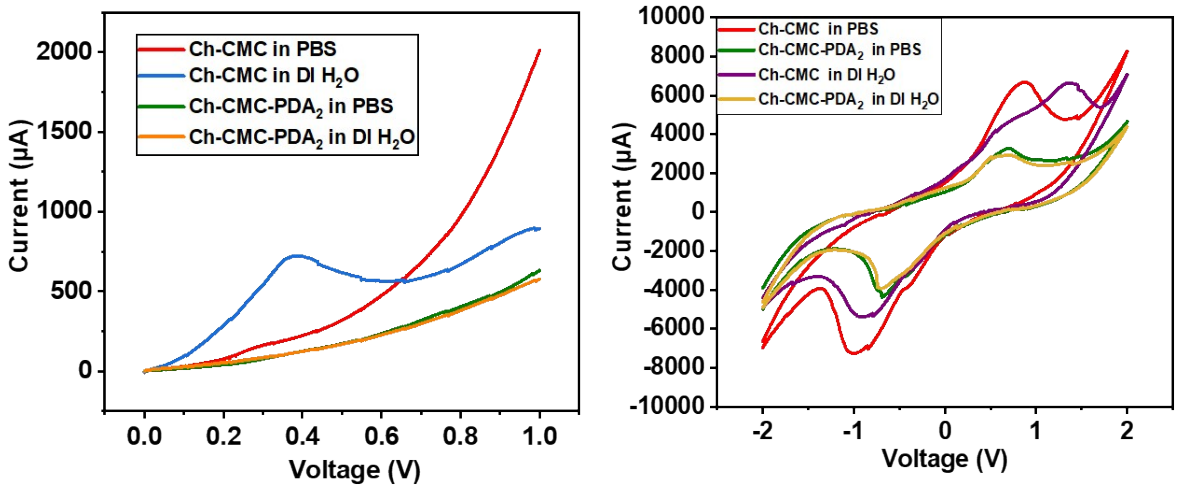

Figure S7. Current-Voltage characteristics of Ch-CMC and Ch-CMC-PDA$_2$ hydrogel swollen in PBS and deionized H_2O

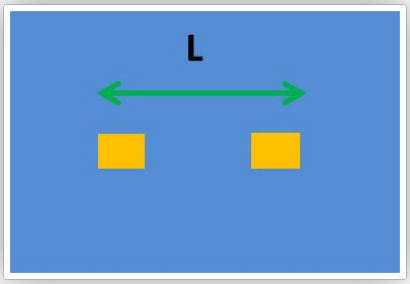

Figure S8. Schematic representation for electrical measurement

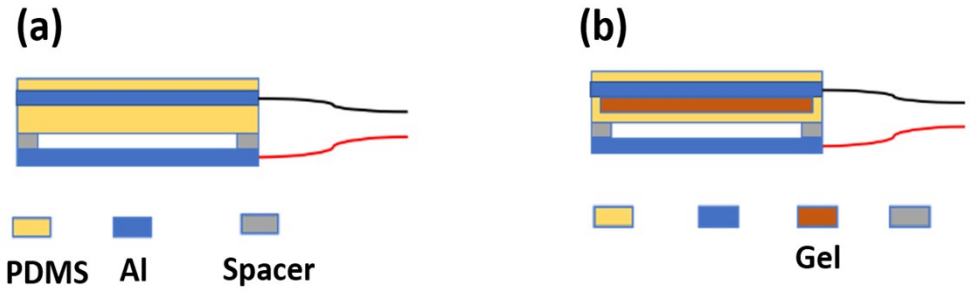

Figure S9. Scheme of device fabrication for TENG (a) Control and (b) Ch-CMC-PDA$_x$

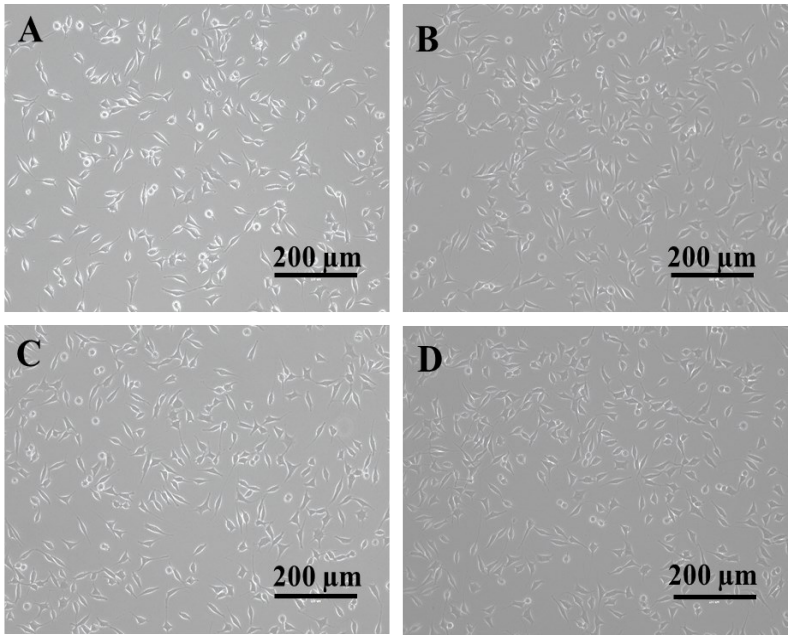

Figure S10. Cytocompatibility studies. Bright field images of L929 cells treated with contact media and incubated for 72 h. (A) Untreated control, (B) Ch-CMC-PDA$_1$, (C) Ch-CMC-PDA$_2$ (D) Ch-CMC-PDA$_3$ respectively.

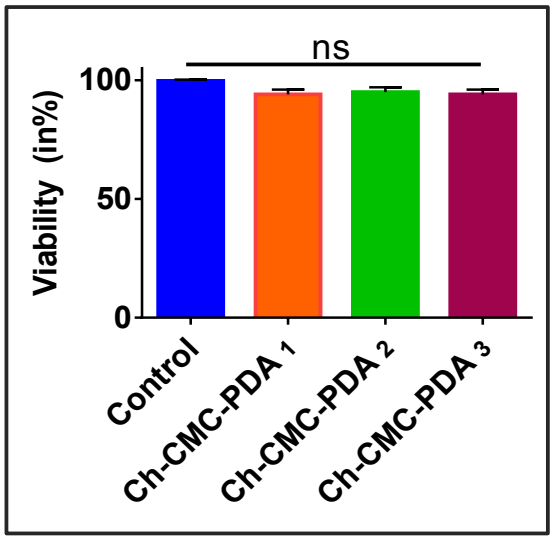

Figure S11. Cell viability on exposure of L929 cells with hydrogel-contact media using MTT assay. Data represents mean ± SD from 3 experiments carried out in triplicate. ns indicates no significant change (One-way ANOVA, Tukey's multiple comparison test).

Table S1. Conductivity comparison with the reported hydrogels

S. No.	Material	Application	Conductivity	Ref.
1.	PEDOT: PSS/peptide−PEG hydrogels	Tissue engineering	8-16×10^{-3} S/cm	[1]
2.	GOxSPNB Hydrogels.	Adhesive	1.05×10^{-2} S/cm	[2]
3.	PNIPAM/L/CNT	Human monitoring motion	1.3-1.9×10^{-3} S/cm	[3]
4.	PDA–pGO–PAM hydrogel	Cell stimulators and implantable bioelectronics	2–10×10^{-2} S/cm	[4]
5.	Chitosan/graphene oxide composite hydrogel	Tissue engineering	0.57-1.22×10^{-3} S/cm	[5]
6.	Poly (NIPAM-co-β-CD) hydrogel	Sensors, human motion sensing	3.5×10^{-2} S/cm	[6]
7.	CS-AT Hydrogel	Cell Delivery Carrier for Cardiac Cell Therapy	2.2-2.4×10^{-3} S/cm	[7]
8.	QCSP/PEGS-FA hydrogel	Wound dressing and cutaneous wound healing	2.25–3.5×10^{-3} S/cm	[8]
9.	Ch-CMC-PDAx hydrogel	Multi-functional hydrogel	0.01-3.4× 10^{-3} S/cm	Our Hydrogel

References

1. [1] Z. Deng, H. Wang, P.X. Ma and B. Guo, *Nanoscale*, 2020, **12**, 1224-1246.
2. [2] Z. Deng, T. Hu, Q. Lei, J. He, P.X. Ma and B. Guo, *ACS applied materials & interfaces*, 2019, **11**, 6796-6808.
3. [3] Y. Wang, F. Huang, X. Chen, X.-W. Wang, W.-B. Zhang, J. Peng, J. Li and M. Zhai, *Chemistry of Materials*, 2018, **30**, 4289-4297.
4. [4] L. Han, X. Lu, M. Wang, D. Gan, W. Deng, K. Wang, L. Fang, K. Liu, C.W. Chan and Y. Tang, *Small*, 2017, **13**, 1601916.
5. [5] X. Jing, H.-Y. Mi, B.N. Napiwocki, X.-F. Peng and L.-S. Turng, *Carbon*, 2017, **125**, 557-570.
6. [6] Z. Deng, Y. Guo, X. Zhao, P.X. Ma and B. Guo, *Chemistry of Materials*, 2018, **30,** 1729-1742.
7. [7] R. Dong, X. Zhao, B. Guo and P.X. Ma , *ACS applied materials & interfaces,* 2016, **8**, 17138-17150.
8. [8] X. Zhao, H. Wu, B. Guo, R. Dong, Y. Qiu and P.X. Ma, *Biomaterials*, 2017, **122**, 34-47.