Supporting Information

Anisotropic and super-strong conductive hydrogels enabled by mechanical stretching combined with the Hofmeister effect

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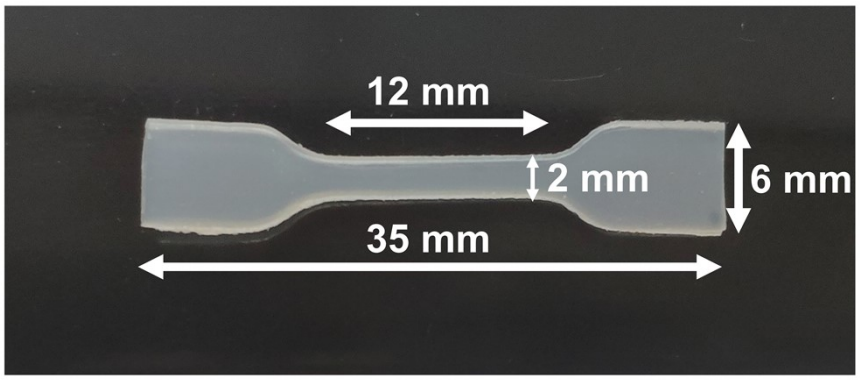

Fig. S1 The dumbbell shape for mechanical tests.

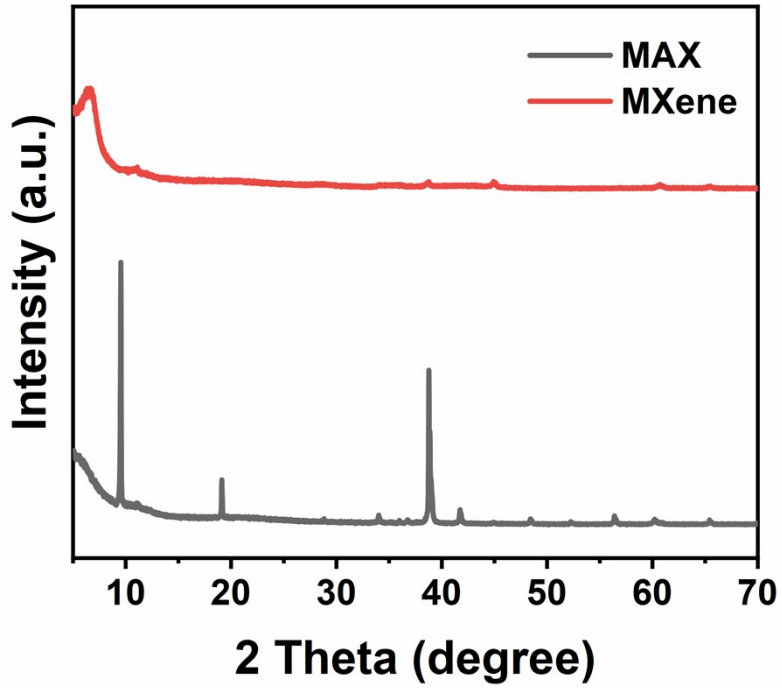

Fig. S2 XRD patterns of Ti_3AlC_2 and $Ti_3C_2T_x$.

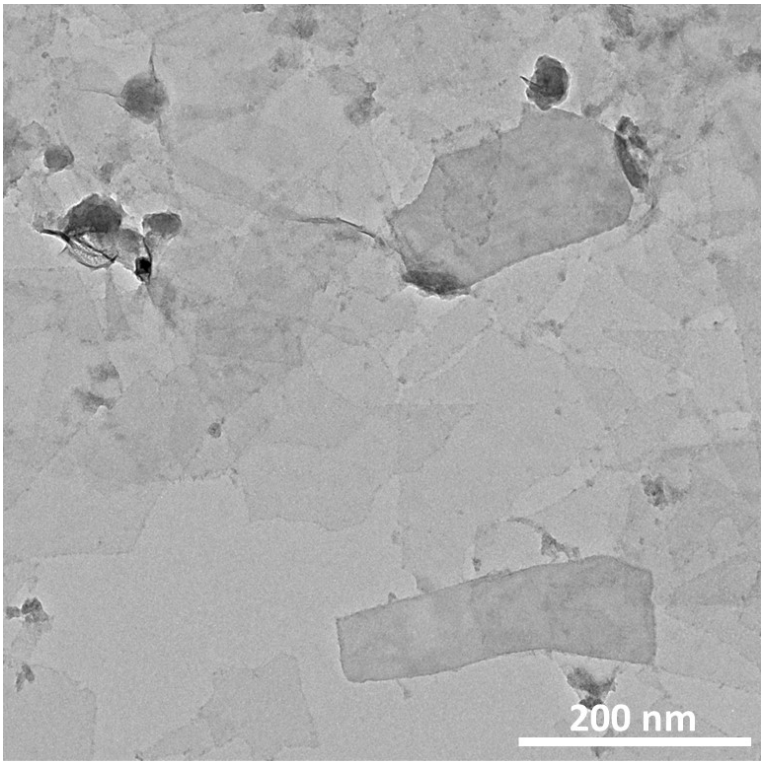

Fig. S3 TEM image of the $Ti_3C_2T_x$.

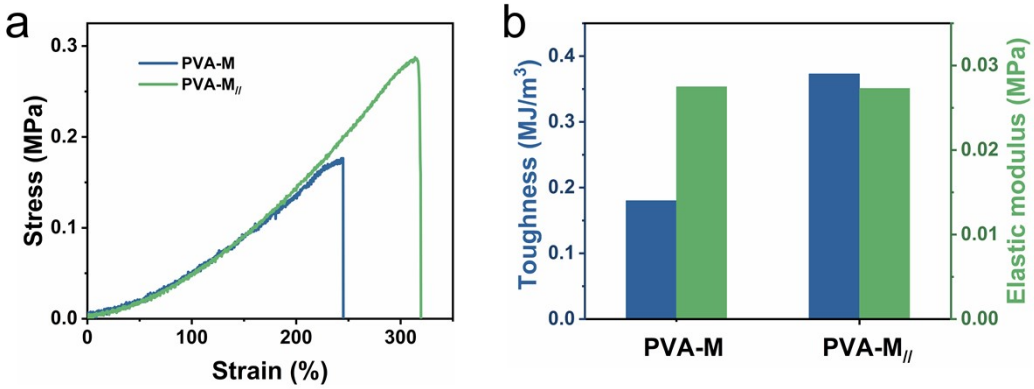

Fig. S4 (a) The tensile stress–strain curves of PVA-M hydrogel and PVA-M$_{//}$ hydrogel. (b) Toughness and elastic modulus of PVA-M hydrogel and PVA-M$_{//}$ hydrogel.

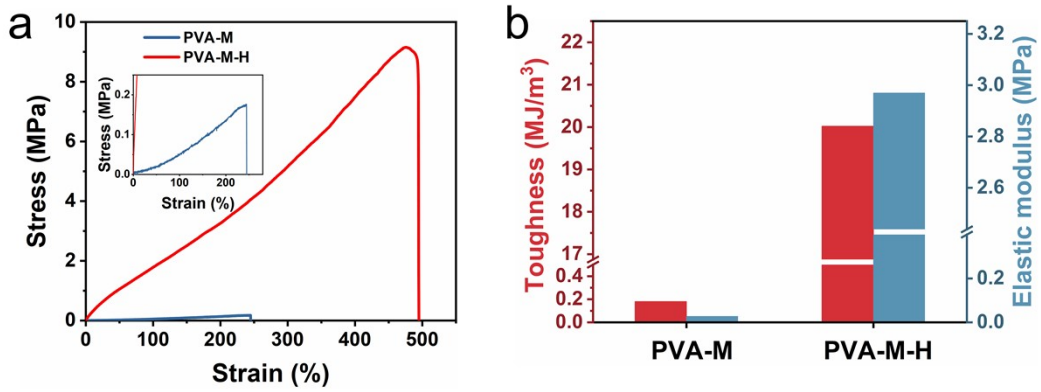

Fig. S5 (a) The tensile stress–strain curves of PVA-M hydrogel and PVA-M-H hydrogel. (b) Toughness and elastic modulus of PVA-M hydrogel and PVA-M-H hydrogel.

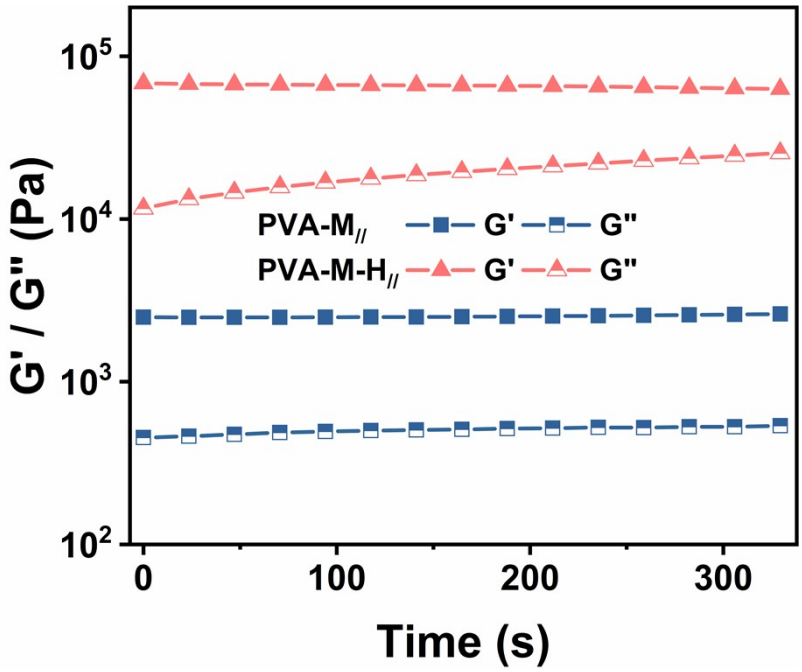

Fig. S6 Rheological behavior of PVA-M$_{//}$ hydrogel before and after immersing in Na_3Cit solution.

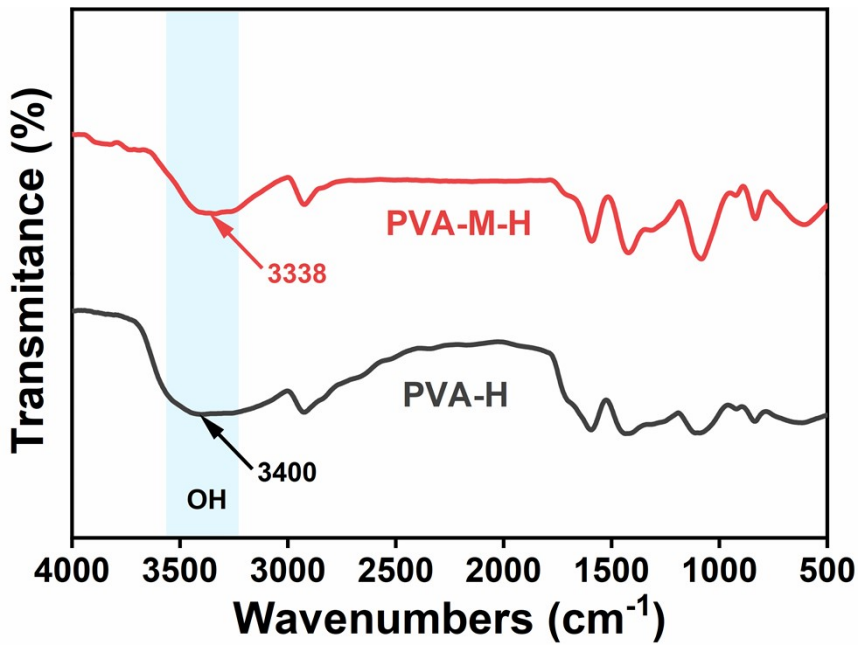

Fig. S7 FTIR spectra of PVA-H hydrogel, and PVA-M-H hydrogel.

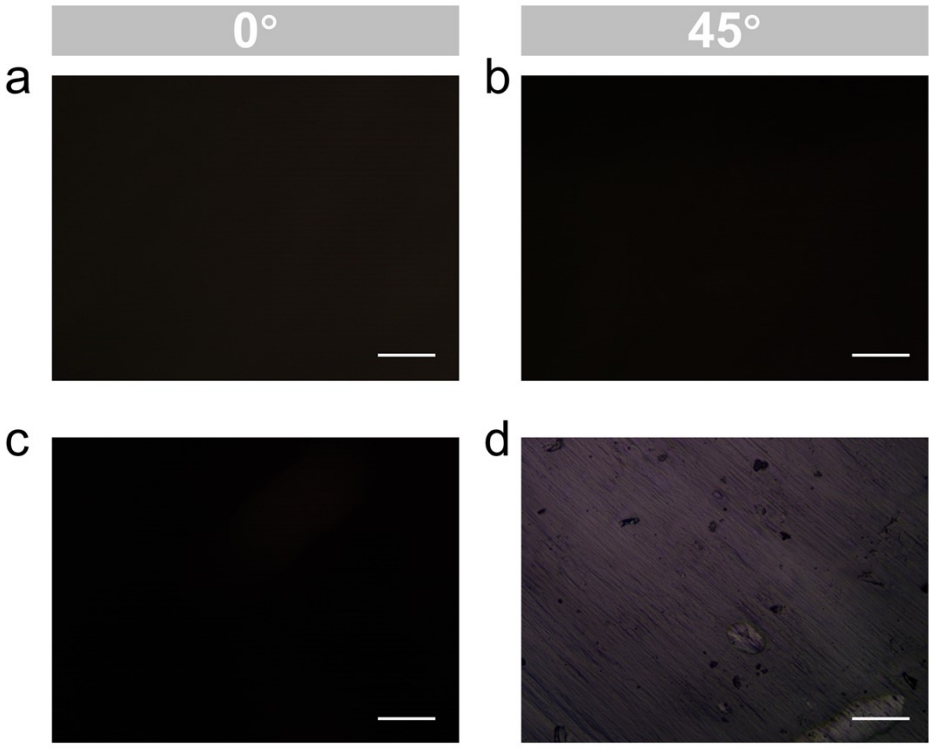

Fig. S8 (a), (b) Polarized microscope images of the isotropic PVA-H hydrogel. (c), (d) Polarized microscope images of the anisotropic PVA-H hydrogel (scale bars: 200 μm).

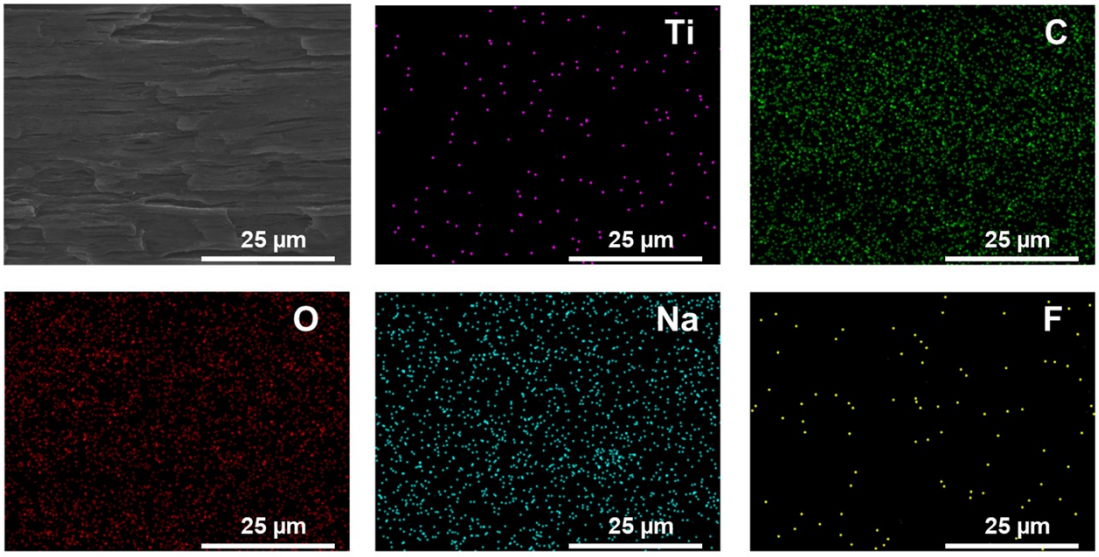

Fig. S9 SEM image and the EDS elemental mapping of Ti, C, O, Na, and F of the cross-sectional of the anisotropic PVA-M-H hydrogel.

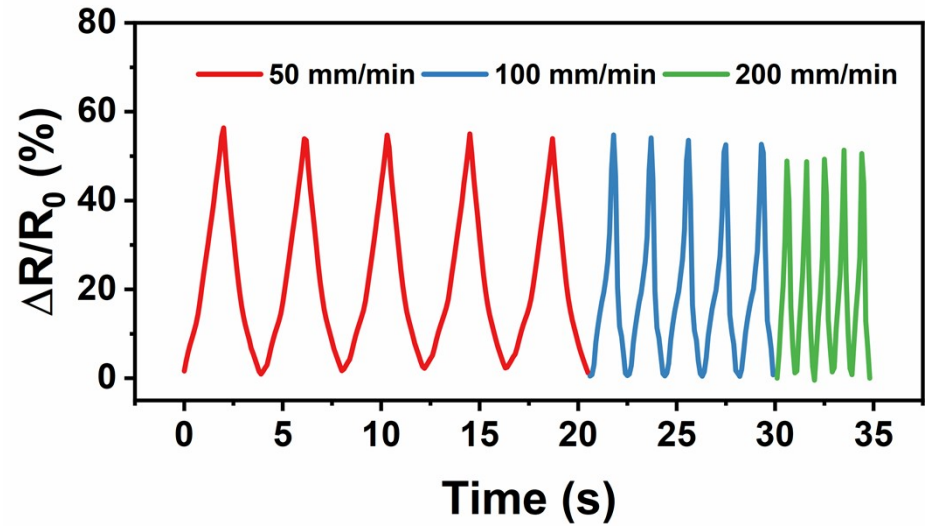

Fig. S10 Relative resistance changes ($\Delta R/R_0$) of PVA-M-$H_{//}$ hydrogel at various stretching rate.

Table S1 Comparison of PVA-M-$H_{//}$ hydrogel to reported tough conductive hydrogels

Materials	Stress (MPa)	Strain (%)	Toughness (MJ/m^3)	Elastic modulus (MPa)	Reference
mechanically trained PVA	5.2	170	N/A	0.2	1
HPC/PVA-NaCl	1.25	800	5.8	0.25	2
PVA-CNF-NaCl	1.4	660	5.25	0.4	3
PVA-Ph/PEDOT	0.8	550	1.1	N/A	4
HA-10PVA	16.1	1,800	200	N/A	5
PVA/NaCl	1.5	550	4.7	0.208	6
PAAm/Ca^{2+}-Alg	32	62.5	N/A	319	7
P(AGA-co-AAm)-Fe^{3+}	12.1	410	N/A	36.1	8
PAM/MC-As	4.4	690	19.3	3.8	9
DN-Sul-Na	7.5	210	N/A	42.5	10
P(AM-co-AA)/CS	5.1	1225	32.1	1.13	11
s-gel-25%	40	240	N/A	40	12
PACT-P	0.0752	600	N/A	N/A	13
PMZn-GL	0.875	247	0.08	0.001	14
PAC@200%-V	0.55	1585	5.75	0.27	15
PVA-M-$H_{//}$	**16.57**	**464**	**39.23**	**8.58**	**This work**

1. S. Lin, J. Liu, X. Liu and X. Zhao, *Proc. Natl. Acad. Sci. USA*, 2019, **116**, 10244-10249.
2. Y. Zhou, C. Wan, Y. Yang, H. Yang, S. Wang, Z. Dai, K. Ji, H. Jiang, X. Chen and Y. Long, *Adv. Funct. Mater.*, 2019, **29**, 1806220.
3. Y. Ye, Y. Zhang, Y. Chen, X. Han and F. Jiang, *Adv. Funct. Mater.*, 2020, **30**, 2003430.
4. H. Wei, M. Lei, P. Zhang, J. Leng, Z. Zheng and Y. Yu, *Nat. Commun.*, 2021, **12**, 2082.
5. M. Hua, S. Wu, Y. Ma, Y. Zhao, Z. Chen, I. Frenkel, J. Strzalka, H. Zhou, X. Zhu and X. He, *Nature*, 2021, **590**, 594-599.
6. Q. Wang, Q. Zhang, G. Wang, Y. Wang, X. Ren and G. Gao, *ACS Appl. Mater. Interfaces*, 2022, **14**, 1921-1928.
7. W. Cui, M. Pi, R. Zhu, Z. Xiong and R. Ran, *J. Mater. Chem. A*, 2021, **9**, 20362-20370.
8. V. T. Tran, M. T. I. Mredha, S. K. Pathak, H. Yoon, J. Cui and I. Jeon, *ACS Appl. Mater. Interfaces*,

2019, **11**, 24598-24608.
9. W. Chen, D. Li, Y. Bu, G. Chen, X. Wan and N. Li, *Cellulose*, 2020, **27**, 1113-1126.
10. X. Sun, Y. Liang, L. Ye and H. Liang, *J. Mat. Chem. B*, 2021, **9**, 7751-7759.
11. Y. Liang, L. Ye, X. Sun, Q. Lv and H. Liang, *ACS Appl. Mater. Interfaces*, 2020, **12**, 1577-1587.
12. P. Lin, T. Zhang, X. Wang, B. Yu and F. Zhou, *Small*, 2016, **12**, 4386-4392.
13. W. Wang, X. Deng and C. Luo, *J. Mater. Chem. C*, 2023, **11**, 196-203.
14. Y. Feng, H. Liu, W. Zhu, L. Guan, X. Yang, A. V. Zvyagin, Y. Zhao, C. Shen, B. Yang and Q. Lin, *Adv. Funct. Mater.*, 2021, **31**, 2105264.
15. L. Chen, X. Chang, J. Chen and Y. Zhu, *ACS Appl. Mater. Interfaces*, 2022, **14**, 43833-43843.