

Supplementary Materials

A dual-network hydrogel sensor via stepwise hydrogen-bond modulation for sensing in underwater and sub-zero environments

Shaojun Fang^{1,#}, Shiyi Yang^{1,#}, Weiqi Shi¹, Jiao Qi¹, Wei Han¹, Zhiping Zhang¹, Xiangchao Zhang¹, Yuxiang Zheng¹, Junhao Chu^{1,2,*}, Rongjun Zhang^{1,3,*}

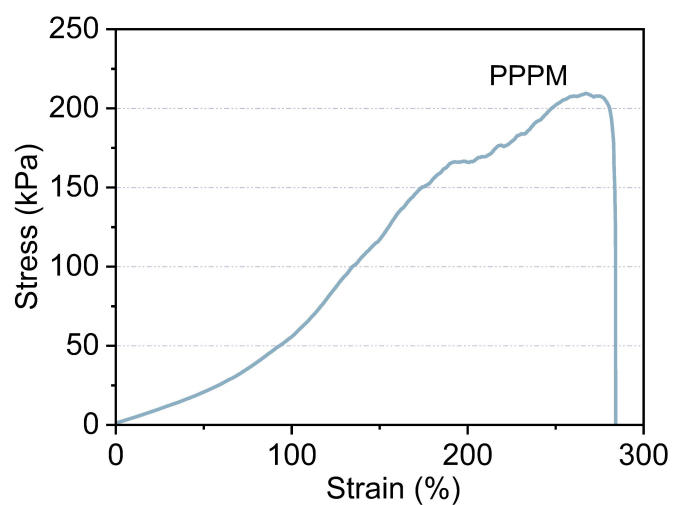
¹Shanghai Engineering Research Center of Ultra-Precision Optical Manufacturing, College of Future Information Technology, Fudan University, Shanghai 200433, China.

²Institute of Optoelectronics, Fudan University, Shanghai 200433, China.

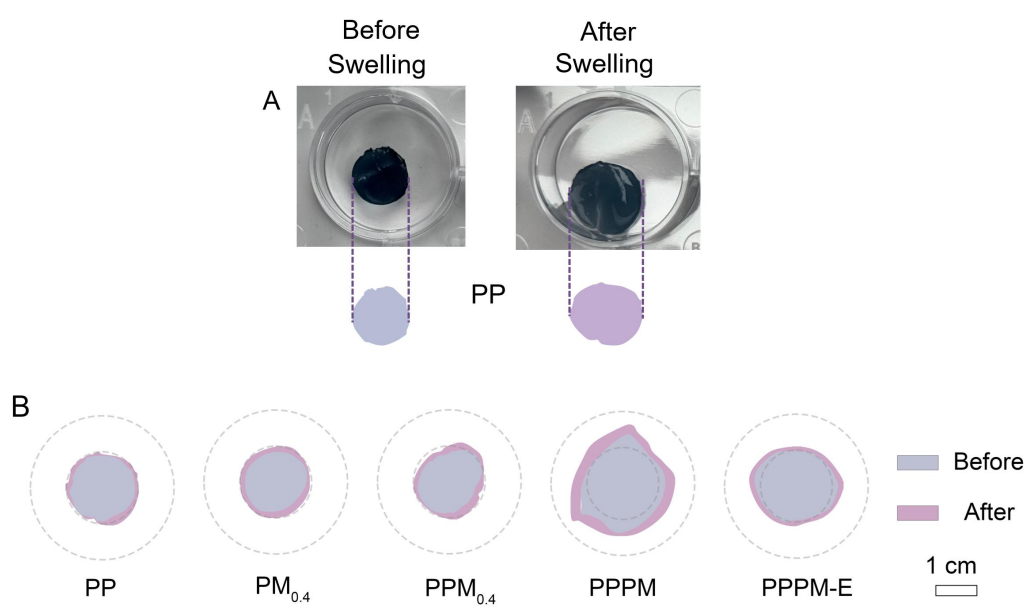
³College of Biomedical Engineering, Fudan University, Shanghai 200433, China.

[#]Authors contributed equally.

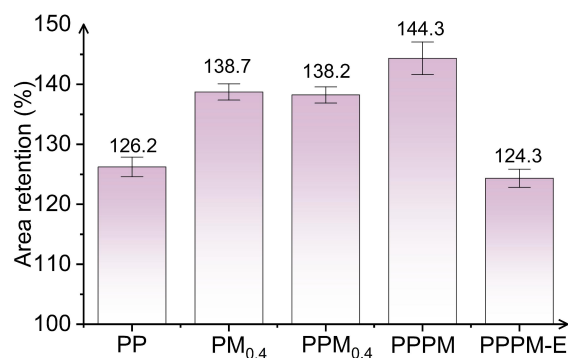
***Correspondence to:** Prof. Junhao Chu, Prof. Rongjun Zhang, Shanghai Engineering Research Center of Ultra-Precision Optical Manufacturing, College of Future Information Technology, Fudan University, Shanghai 200433, China. E-mail: jhchu@mail.sitp.ac.cn; rjzhang@fudan.edu.cn



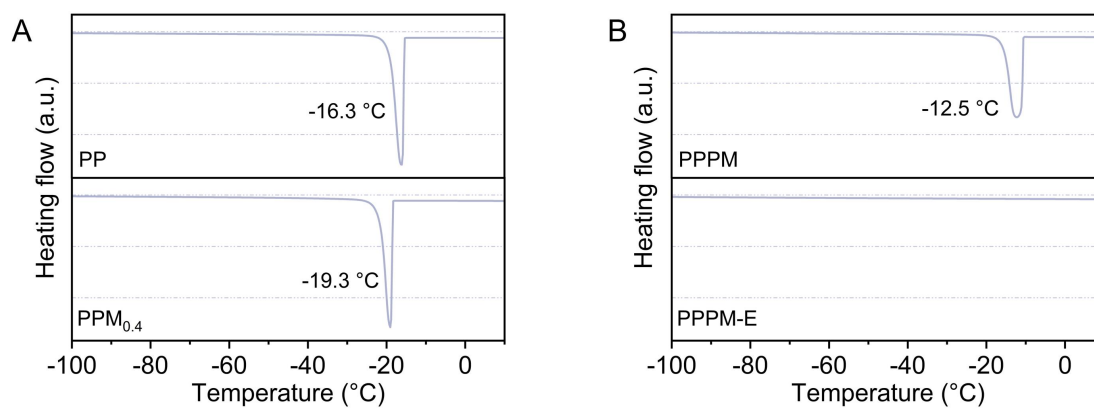
Supplementary Figure 1. Stress-strain curve of PPPM.



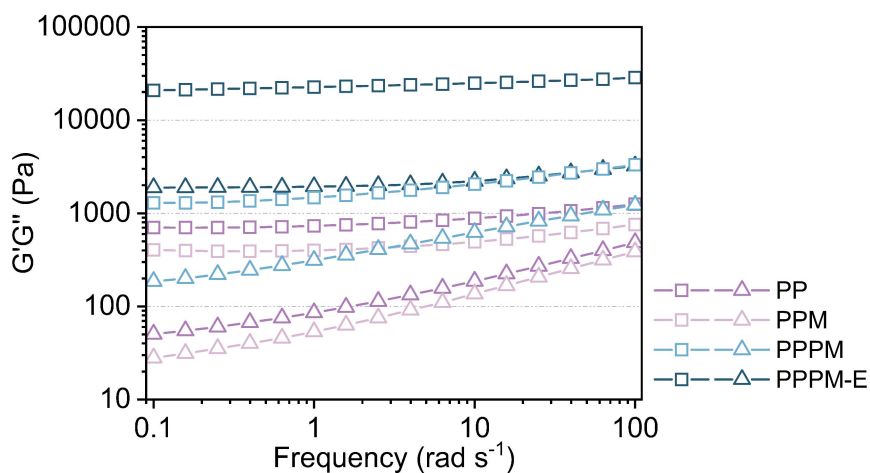
Supplementary Figure 2. (A) Schematic illustration of the swelling-induced area change; (B) Comparison of area changes for different hydrogels before and after swelling.



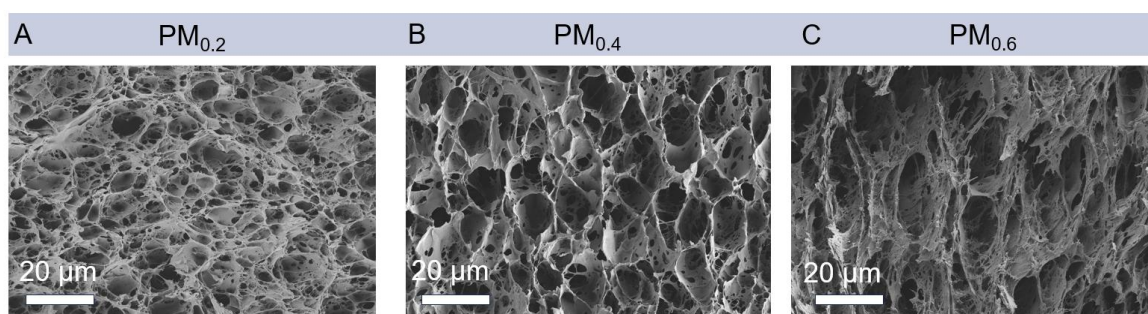
Supplementary Figure 3. Area change rate after swelling for different hydrogels (n = 3).



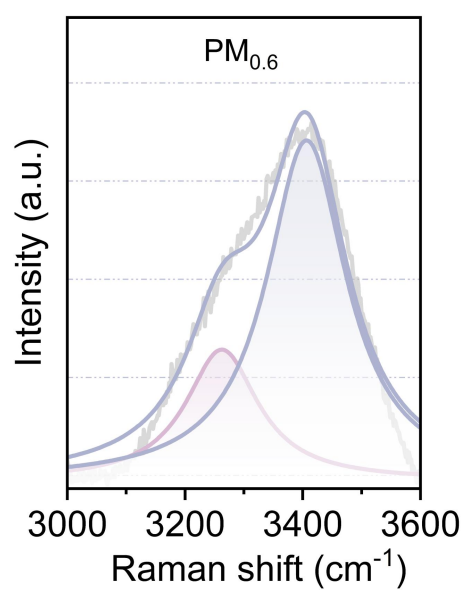
Supplementary Figure 4. (A) Differential scanning calorimetry (DSC) curves of PP and PPM_{0.4}; (B) DSC curves of PPPM and PPPM-E.



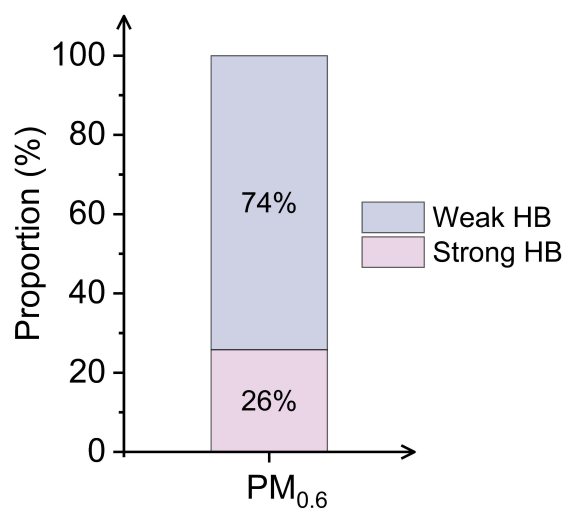
Supplementary Figure 5. Rheological test results of different hydrogels.



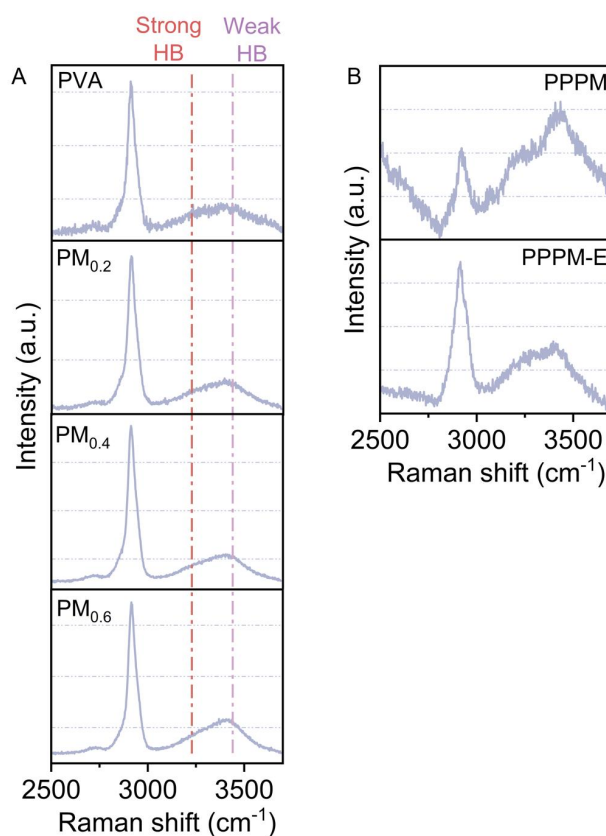
Supplementary Figure 6. SEM images of (A)PM_{0.2}, (B)PM_{0.4}, (C)PM_{0.6}.



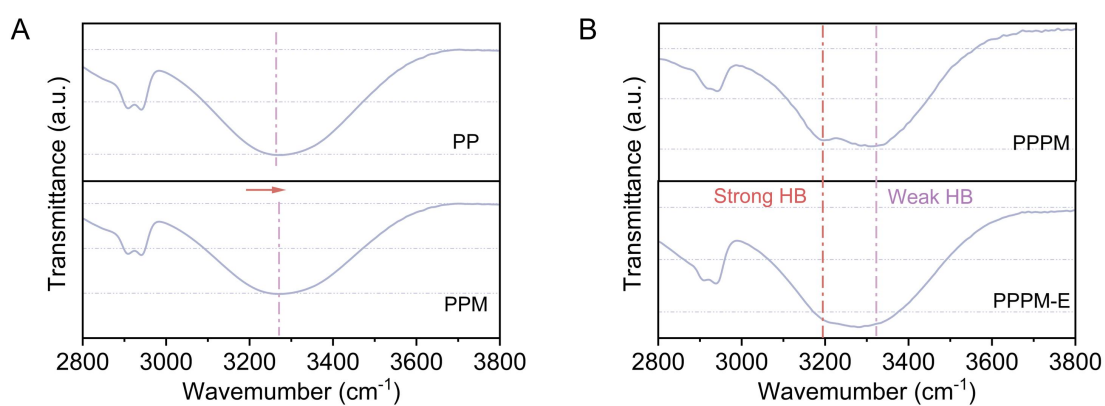
Supplementary Figure 7. Raman curves of PM_{0.6}.



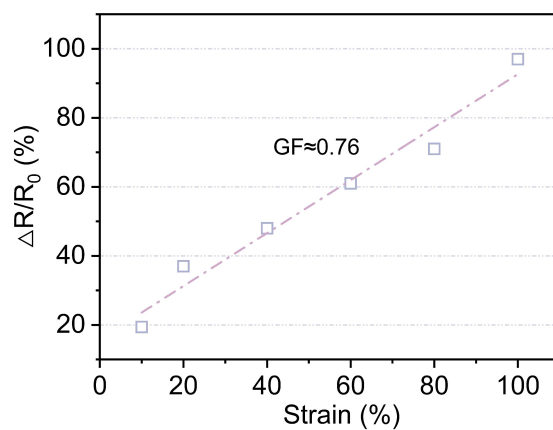
Supplementary Figure 8. Proportion of weak HB and strong HB in PM_{0.6}.



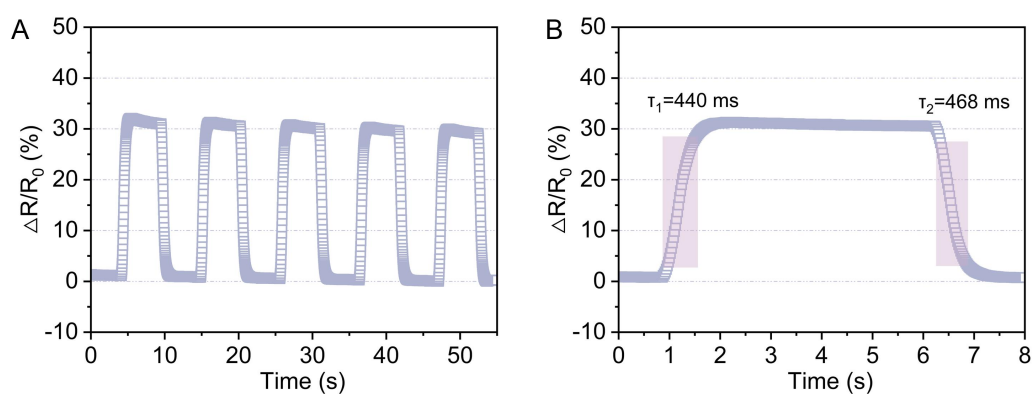
Supplementary Figure 9. Raman results of hydrated hydrogels: (A) PVA and PM_x; (B) PPPM and PPPM-E.



Supplementary Figure 10. FTIR results of (A) PP and PPM; (B) PPPM and PPPM-E.



Supplementary Figure 11. The Gauge Factor (GF) curve of the PPPM-E hydrogel.



Supplementary Figure 12. (A) Rapid tensile cycling curves of the PPPM-E hydrogel; (B) Response time curve.