Electronic Supplementary Material (ESI) for Chemical Communications

Supporting Information for

Independent multifunctional detection by wettability controlled inverse opal hydrogels

By *Wei Hong, Haoran Li, Xiaobin Hu*, Binyuan Zhao, Fan Zhang** and *Di Zhang**

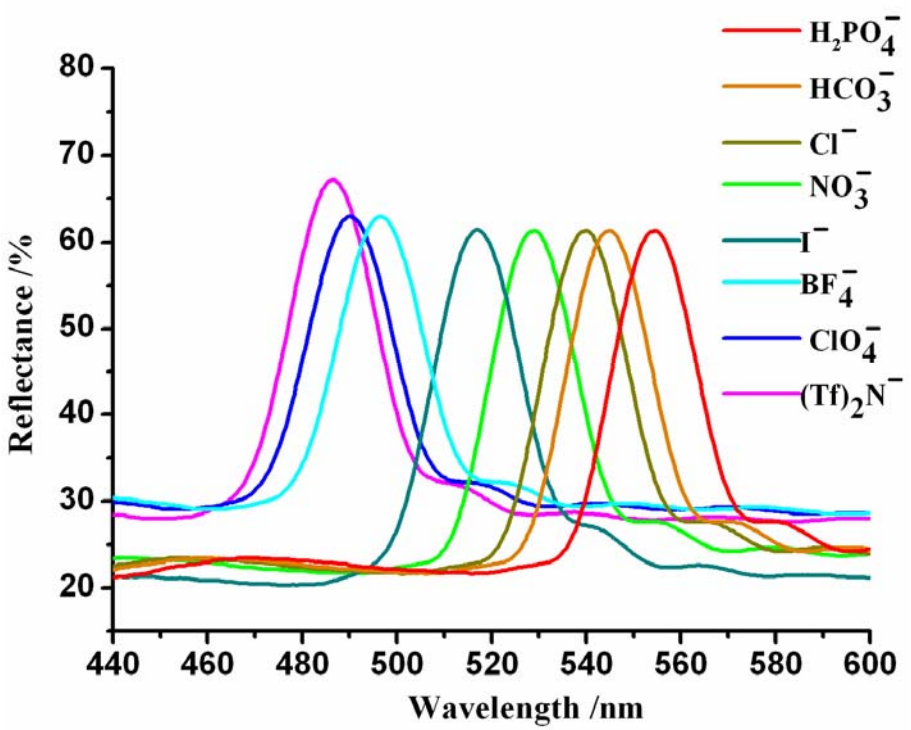

Figure S1. Reflectance spectra of the PASPF in this work upon soaking in diversified 0.02M anions aqueous solutions. The diffraction wavelength of the PASPF was related to the hydration enthalpies of the anions. The higher hydration enthalpies the anions have, the larger diffraction wavelength the PASPF shows. [1]

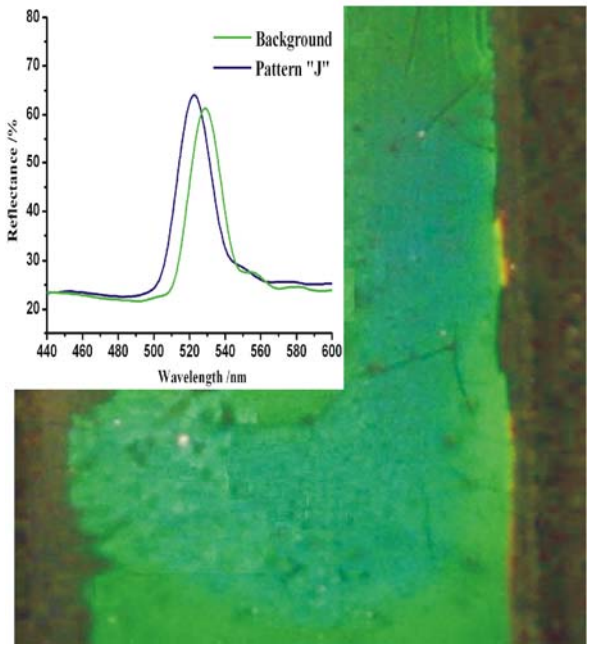

Figure S2. Image contrast by 6nm wavelength shift of the PASPF in this work: "J"-522nm and background (the rest part of the film)-528nm.

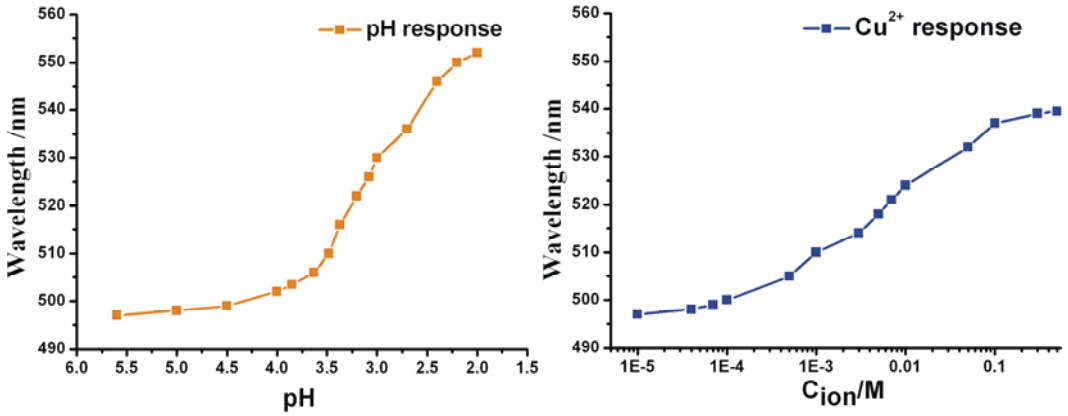

Figure S3. Effects of pH and Cu^{2+} on the diffraction maximum from P4-PF.

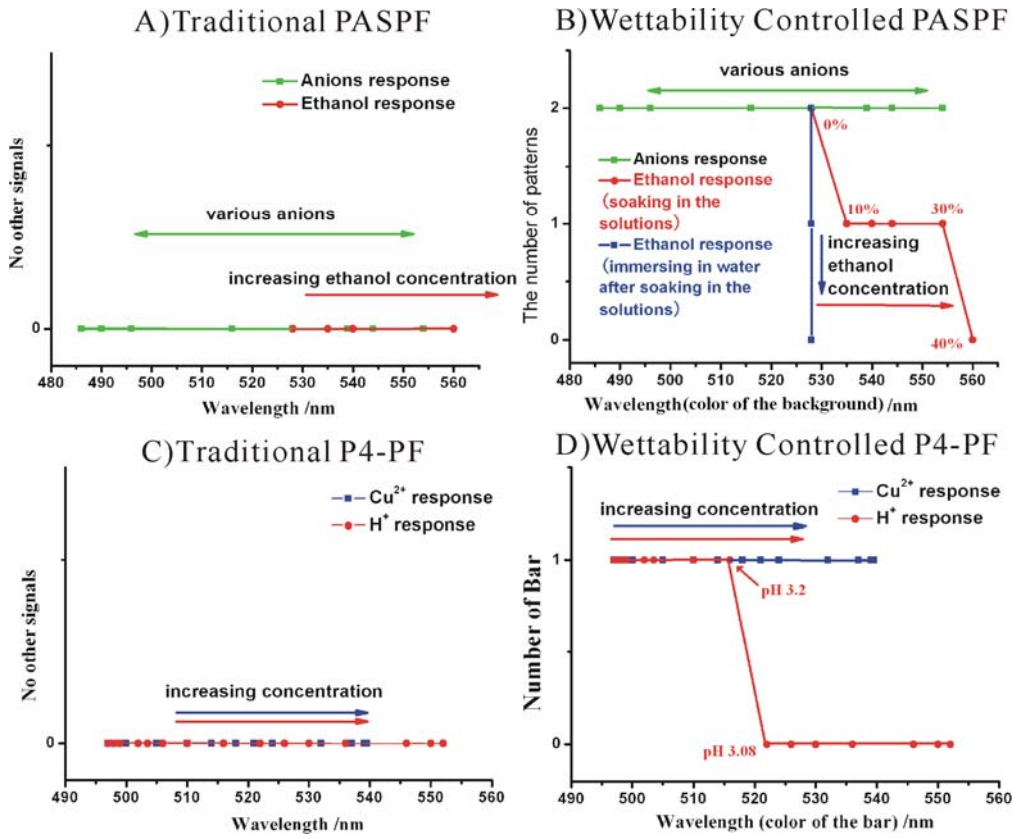

Figure S4. Comparison of the traditional photonic hydrogel and the wettability controlled photonic hydrogel in this work.

A) Traditional PASPF: diffraction wavelength response to various anions (based on Fig.S1) and different enthanol concentrations (0%-40%).

B) Wettability controlled PASPF: diffraction wavelength response to various anions with wettability response to different enthanol concentrations (0%-40%). (based on Fig.2)

C) Traditional P4-PF: diffraction wavelength response to Cu^{2+} (based on Fig.S3) and pH (0%-40%).

D) Wettability controlled P4-PF: diffraction wavelength response to Cu^{2+} and pH, with wettability response to pH. (based on Fig.3)

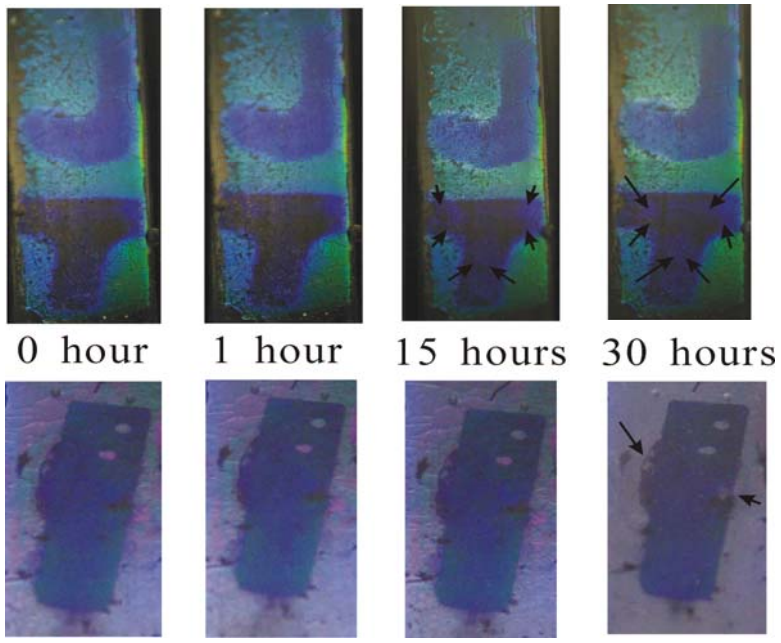

Figure S5. Durability of the patterns of PASPF and P4-PF in water. For the first few hours, no significant change was observed on PASPF and P4-PF. After 30 hours immersing in water, the patterns on PASPF were partly infiltrated by water from the edge part (marked by the arrow) of the patterns due to the ionic PASPF could absorb water slowly from the swelled part (the background), but it was still far from fully swelling, while P4-PF displayed no significant change due to the hydrophobic nature of the P4-PF. Further more, some edge parts (marked by the arrow) of the pattern seemed to be occupied by air (or collapsed).

Experimental

Chemicals: All solvents and chemicals are of reagent quality and were used without further purification unless special explanation. Ethylene glycol dimethylacrylate (EGDMA), sodium fluoroborate ($NaBF_4$) and bistrifluoromethanesulfonimide lithium salt (Tf_2NLi) were obtained from Acros. Methacrylatoethyl trimethyl ammonium chloride (DMC), 2-hydroxy-2-methylpropiophenone (HMPP) and 4-vinylpyridine were obtained from TCI. Other solvents and chemicals were supplied by local suppliers.

Formula of homogeneous monomer precursor for the photonic polyelectrolyte films:

Anions-responsive film (PASPF): 140ul 80%DMC aqueous solution (0.6mmol, TCI), 105ul Methyl methacrylate (1mmol), 72ul EGDMA (0.38mmol, Acros) and 2ul HMPP were mixed in a mixing solvent of 220ul acetic acid and 40ul water.

Cu^{2+} and pH-responsive film (P4-PF): 52ul 4-vinylpyridine (0.5mmol, TCI), 105ul Methyl methacrylate (1mmol), 28ul EGDMA (0.15mmol, Acros) and 1ul HMPP were mixed in 160ul ethanol.

Monodispersed silica particles and were synthesized by a modified Stöber method.[2]

After degassing by nitrogen for 10 min, the homogeneous monomer precursors (the formulas see in Supporting Information) were dropped onto silica arrays. Excess precursors were removed by covering a PMMA slide (50mm*10mm*1.5mm) and the remaining mixture was photopolymerized under an UV light at 365nm for 70min. The sandwich was immerged into 1.2% hydrofluoric acid solution for at least 20min to separate double slides and fully etch the silica colloids. After washed by an amount of deionized water, the inverse opal film on PMMA substrate was ready for signaling test.

Treatment for patterning on the inverse opal films: after dried, PASPF with NO_3^- (or other hydrophilic anions like HCO_3^- and Cl^-) was covered with patterned filter papers and the corresponding solutions were dropped onto the filter papers. Finally, the film was washed by pure water and dried before use. P4-PF was treated similarly but finally dried directly without water washing.

The optical response of the photonic polyelectrolyte films was measured by using an OceanOptics Maya 2000 fiber optic spectrometer. “Contact angle”s (CAs) were measured on a dataphysics Germany OCA20 contact-angle system. An average CA value was obtained by measuring the same sample at five different positions. The microstructure of the inverse opal film was observed under FEISirion200 SEM with an accelerating voltage of 5 kV. Before imaging, the samples were arc-coated with a thin gold film. The color images of the inverse opal films were recorded by a common digital camera under an incandescent lamp.

Reference:

[1] Y. J. Marcus, *J. Chem. Soc., Faraday Trans.* 1991, **87**, 2995.
[2] W. Stöber, A. Fink, E. Bohn, *J. Colloid Interface Sci.* 1968, **26**, 62.