Supporting Information

Colorimetric logic response based on aptamer functionalized colloidal crystal hydrogels

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I Experiment section

Chemicals and Materials. Aptamers (**Table 1S**) were synthesized by Invitrogen Biotechnology Co., Ltd (Shanghai, China) and purified by standard desalting.

Table S1 Sequences of aptamers used in this work.

Aptamer sequence	Name
5'-NH_2–$(CH_2)_6$– TTCTTTCTTCCCCTTGTTTGTT–$(CH_2)_6$–NH_2-3'	A1
5'-NH_2–$(CH_2)_6$– CTCTCTTCTCAAAAAACACAACACAC –$(CH_2)_6$–NH_2-3'	A2

Acrylamide (98%, AA), mercury(II) perchlorate and silver(I) acetate were purchased from Alfa Aesar China Ltd. Poly(ethylene glycol) diacrylate (PEGDA, MW 700) and 2-hydroxy-2-methylpropiophenone photoinitiator were purchased from Sigma (St. Louis, MO, USA). All other metal ion reagents were of analytical reagent grade and were used without further purification or treatment. N-(3-Dimethylaminopropyl)-N′-ethylcarbodiimide (EDC), N-hydroxysuccinimide (NHS), 2-(N-Morpholino)ethanesulfonic acid (MES) and tris(hydroxymethyl)aminomethane (Tris) were purchased from Aladdin. Milli-Q (Millipore, Bedford, MA) water with ultraviolet (UV) sterilization was used throughout the experiment.

Characterization. Photographs of CCHs were obtained with a Canon digital camera (EOS 5D Mark II). Reflection spectra of CCHs were obtained at a fixed 90° glancing angle utilizing an optical microscope equipped with a fiber-optic spectrometer (Ocean Optics, USB2000-FLG). The microstructures of the CCHs were characterized by a scanning electron microscopy (SEM, Hitachi, S-300N).

Fabrication of CCHs. Monodisperse silica colloidal nanoparticles were synthesized

by the Stöber–Fink–Bohn method. The nanoparticles used in this study were 145 nm in diameter. The purified colloidal nanoparticles were dispersed in pure water, and shaken with ion-exchange resin to form a nonclose-packed colloidal crystal array. The CCHs were fabricated by free-radical solution photopolymerization using HMPP as photoinitiator. In a typical recipe, the pregel solution was composed of 12% (v/v) AA/BisAA, 1% (v/v) PEGDA, 1% (v/v) HMPP and 22% (w/v) of the above CCA solution. The pregel solution was injected into the polymerization cell, which consisted of two quartz disks separated by 125 μm thick Parafilm spacers and exposed to 365 nm UV light (100 W, 10 min) to polymerize the pregel solution. The resulting CCH was rinsed with pure water to remove any unreacted prepolymer and stored in the hydrated state. Before use, the large area CPCH film were cut into uniform pieces.

Preparation of aptamer crosslinked CCHs. The aptamer crosslinked CCHs were prepared as described elsewhere. (wenxian)

Logic performance. The aptamer crosslinked CCH was first equilibrated in reaction buffer (20 mM NaNO3, 8 mM Tris nitrate, pH 7.5 (NT buffer)) in a polypropylene tube (diameter: 1.2 cm). Then, different concentrations of input ions (Hg^{2+}/Ag^{+}) or 100 μM of other metal ions were introduced and incubated in test tubes at 25 °C for 30 min. After extensive washing with the reaction buffer, the reflection spectra and the Photograph of the CCH were measured in reaction buffer at room temperature.

II Photograph of the aptamer functionalized CCH in present of different targets.

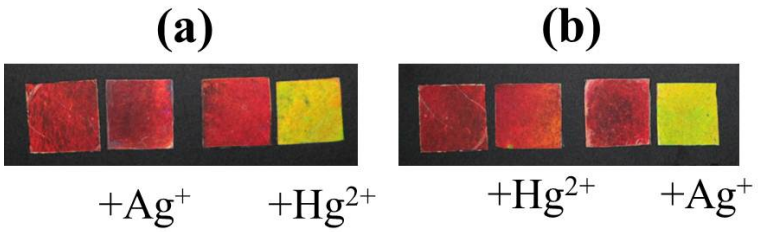

Figure S1 Diffraction color of A1 hydrogel (a) and A2 hydrogel (b) in the presence of different targets. The concentration of the targets was 0.10 μmol.

III The specificity of the aptamer functionalized CCH.

Table S2 The reflection wavelength shift (nm) of A1-CCH and A2-CCH upon different metal ions. (0.1 uM for Hg^{2+} and Ag^{+}, 1.0 uM for other metal ions)

	Hg^{2+}	Ag^{+}	Pb^{2+}	Cu^{2+}	Zn^{2+}	Mg^{2+}	Ca^{2+}	Al^{3+}	Fe^{3+}
A1-CCH	37	0	0	1	0	0	1	0	2
A2-CCH	4	32	1	0	0	0	1	0	1

IV Relationship of input ion concentration and the reflection wavelength blue shift.

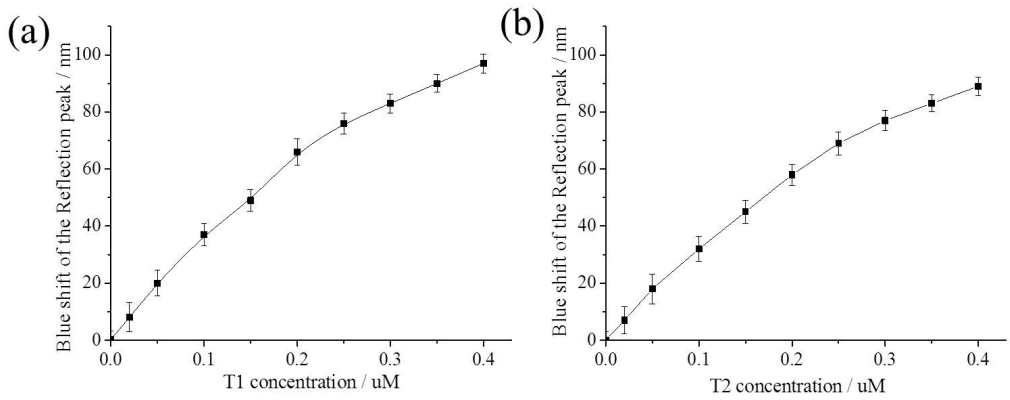

Figure S2 Diffraction blue shift as a function of Hg^{2+} concentration (a) and Ag^{+} concentration (b). Error bars represent the standard deviation of three experiments.

V The logic swelling kinetics of CCH.

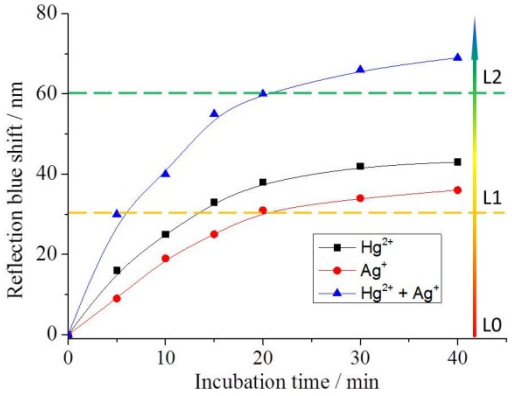

Figure S3 The swelling kinetics of hydrogel with A_{Hg} and A_{Ag} in the presence of Hg^{2+} and Ag^{+} added separately or simultaneously.