Supplementary Information for

A novel logic gate based on liquid-crystals responding to the DNA conformational transition

Fubing Xiao,[a] Hui Tan,[b*] Yan Wu,[a] Shuzhen Liao,[a] Zhaoyang Wu,[a*] Guoli Shen,[a] and Ruqin Yu[a]

a. State Key Laboratory of Chemo/Biosensing and Chemometrics, College of Chemistry and Chemical Engineering, Hunan University, Changsha 410082, P. R. China. E-mail: zywu@hnu.edu.cn.

b. Technology Center of Juhua Group, Quzhou, 324004, P. R. China. E-mail: jane198510@126.com.

1. Materials and methods

1.1 Materials

Microscopy glass slides were purchased from Xinhua Laboratory Glassware Company (Haimen, China). Copper grids (200-mesh) were obtained from Zhongjingkeyi Technology Co., Ltd. (Beijing, China). 4-cyano-4′-pentylbiphenyl (5CB, a nematic LC) was obtained from International Laboratory USA. (South San Francisco, USA). N, N-dimethyl-n-octadecyl-3-aminopropyltrimethoxysilyl chloride (DMOAP) was purchased from Sigma-Aldrich. $AgNO_3$ was purchased from Shanghai Fine Chemical Materials Research Institute (Shanghai, China). $Hg(NO_3)_2{\cdot}H_2O$ was purchased from Tianjin Fengchuan Chemical Reagent Science and Technology Co., Ltd. (Tianjin, China). DNA probe (5′-CCCCTTTTCCCCTTTTCCCCTTTTCCCC-3′) was obtained from TaKaRa Biotechnology Co., Ltd. (Dalian, China). 3-Morpholinopropanesulfonic acid (MOPS) and SYBR Green I (SG I, 10,000×) were purchased from Beijing Dingguo Changsheng Biotechnology Co., Ltd. (Beijing, China). Other reagents were of analytical purity. Ultrapure water (18.2 MΩ) was used in all aqueous solution.

1.2 Preparation of Optical Cells

The optical cells were constructed following the reported procedure.[1] Briefly, the cleaned glass slides were firstly submerged in N, N-dimethyl-n-octadecyl-3-aminopropyltrimethoxysilyl chloride (DMOAP) solution (0.2% v/v) to form the monolayer of DMOAP on the surface. Secondly, the copper grids were placed onto DMOAP-treated glass slide, and the LC was dispensed onto the copper grid using a 30 μm capillary tube. Finally, the LC-filled grids were immersed in the solution containing samples of interest (25 μL).

1.3 Construction of the logic gates

For the “AND” logic gate construction, all possible combinations of input Ag^+ and input Hg^{2+} were incubated with 1 μM probe DNA in the 10 mM MOPS buffer (pH

7.2, 25 mM $NaNO_3$) for 2 min. Then, the LC-filled grids were covered with the solution of these samples, and the optical images were obtained at 25 °C after 20 min under polarized light microscope.

1.4 Polarized light microscopy measurements

A polarized light microscope (Nikon ECLIPSE 50iPOL, Tokyo, Japan) was used to image the optical appearance of the LC system in transmission mode with crossed polarizers (50% maximum light intensity, 40% open aperture). All optical microscopy images were obtained by Mshot MD50 digital camera (Guangzhou, China) mounted on the microscope with a gain of 58 and a exposure time of 24.79 ms, and images were analyzed by *Image J* to determine the average grayscale value.

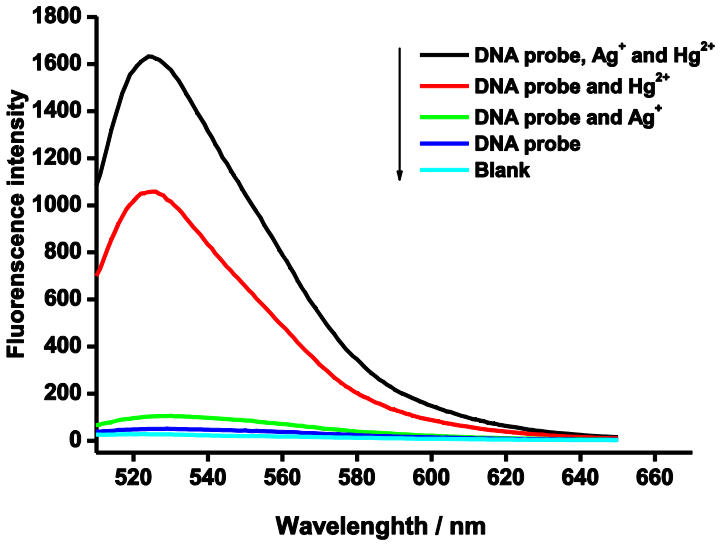

Fig. S1 The fluorescence spectra of SG I in different solutions, the concentration of DNA probe, Ag^+ and Hg^{2+} were 0.5 μM, 5 μM and 5 μM, respectively.

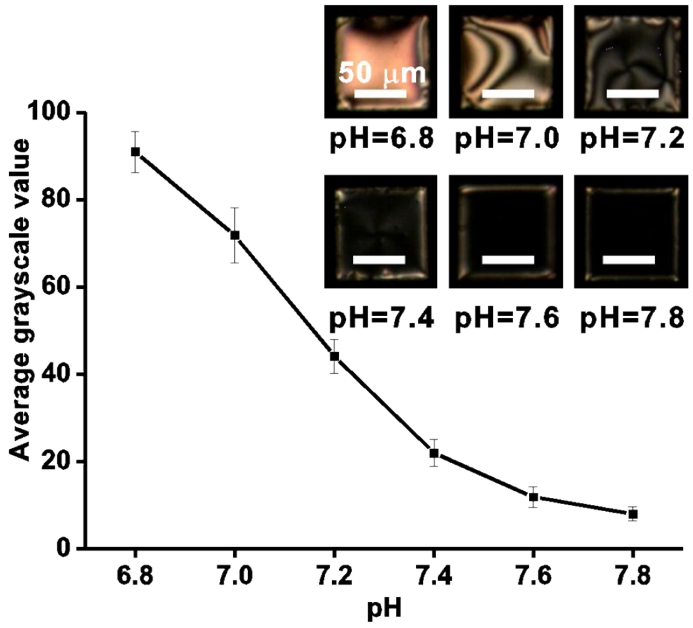

Fig. S2 Optical responses of LC cells in different pH values of MOPS buffer solutions. All error bars represent the standard deviation from three independent trials.

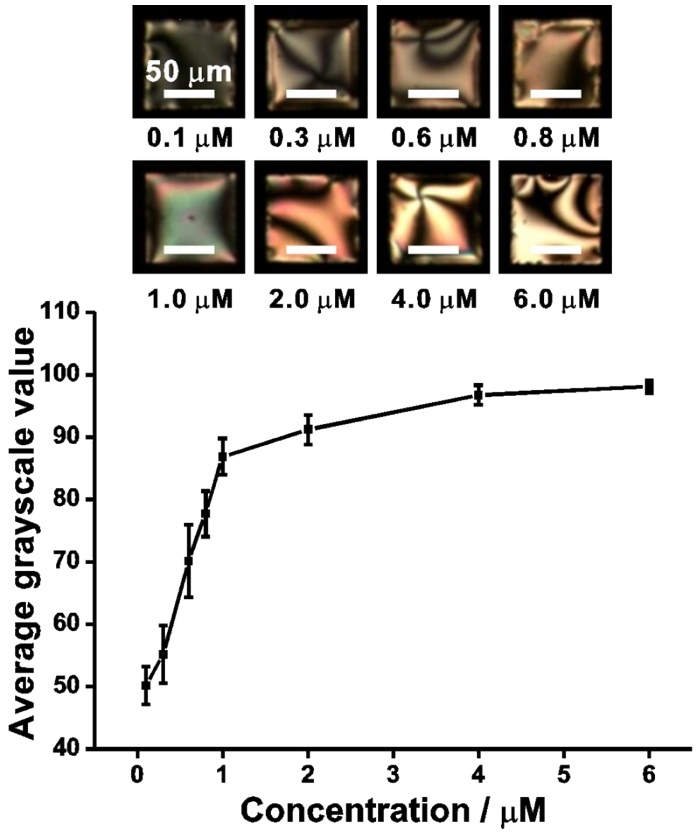

Fig. S3 Optical responses of LC cells under crossed polarizers to different concentration of DNA probe. The response time was 20 min. All error bars represent the standard deviation from three independent trials.

References:

1 H. Tan, X. Li, S. Liao, R. Yu and Z. Wu, *Biosens. Bioelectron.*, 2014, **62**, 84-89.