A facile one-step synthesis of fluorescent silicon quantum dots and their application for detecting Cu^{2+}

Bo Liao, * [a, c] Wu Wang,[a] Xiaoting Deng,[a] Benqiao He,* [b] Wennan Zeng,[a] Zilong Tang,[c] and Qingquan Liu[a]

[a]School of Chemistry and Chemical Engineering, Hunan University of Science and Technology, Xiangtan, 411201, China

[b]State Key Laboratory of Separation Membranes and Membrane Processes, Tianjin Polytechnic University, Tianjin, 300387, China

[c]Key Laboratory of Theoretical Organic Chemistry and Functional Molecule, Ministry of Education, Hunan University of Science and Technology, Xiangtan, 411201, China

Materials

Silicon wafer (nitrogen-doped (n-type), 0.01-0.02 sensitivity) was purchased from Hefei Kejing Materials Technology Co., Ltd (China). Silicon powder was obtained by grinding Si wafer with an agate mortar and agate pestle for 1h. The water used was double-distilled water, and other chemicals used as received were of analytical reagent grade.

Measurements

Transmission electron microscopy (TEM) observation was performed on a Hitachi-7650 electron microscope operating at 100 kV, using copper grid covered carbon membrane as support membrane. Fluorescence spectra (FL) were characterized with a Hitachi F-4500 fluorescence spectrophotometer at room temperature. Ultraviolet (UV)-visible spectra were recorded with a Perkin-Elmer Lambda 25 instrument. Fourier-

Bo Liao, lb@hnust.edu.cn, Benqiao He, hebenqiao@tjpu.edu.cn

transform infrared (FTIR) spectra were obtained by using a Nicolet Avatar 360 FTIR spectrophotometer.

Synthesis of the fluorescent Silicon Quantum Dots (Si QDs)

The fuorescent Si QDs were synthesized by a hydrothermal method as shown in Fig. S1. A certain amount (100-300 mg) of Silicon powder was added with 18 mL of water in a hydrothermal reactor and sealed, then heated at 200℃ for 2-8h. After the reaction, the reactants were cooled down naturally to room temperature. Then, the obtained solution was centrifuged at a high speed (5000 $r \cdot min^{-1}$) for 2 min to remove the unconverted reactants. The upper transparent solution exhibited strong blue-green luminescence with light irradiation at 365 nm, and which was the solution containing Si QDs. The Si QDs solution was dried to obtain powder for the following use.

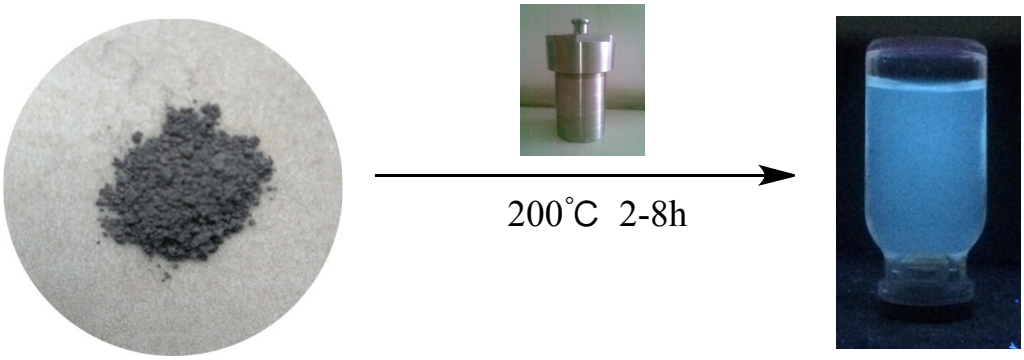

Fig. S1. Schematic representation of the synthesis of fluorescent Si QDs.

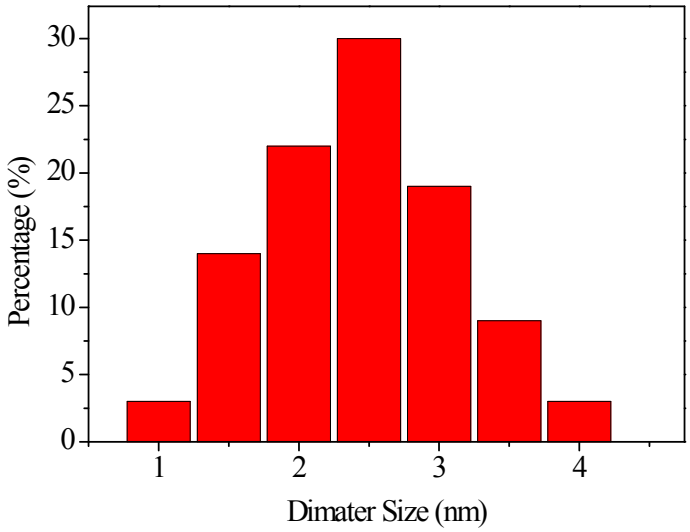

Fig. S2 The size distribution of the Si QDs prepared with etching Si powder for 2 h at 200 ℃

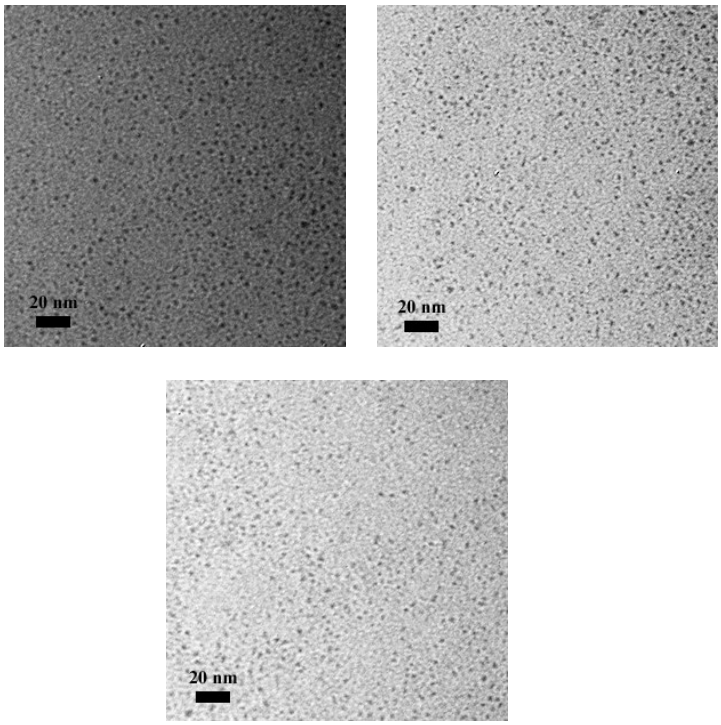

Fig. S3 The TEM pictures of the Si QDs prepared by etching the Si powder for different time(the etching time is 4 h, 6 h and 8h from to left to right)

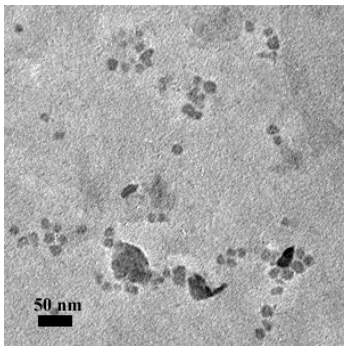

Fig. S4 The TEM pictures of the pristine Si powder with small size（the sample was prepared as following : the pristine Si powder was dispersed in water and then centrifuged at a high speed (5000 $r \cdot min^{-1}$) for 2 min to remove the part with bigger size, the upper transparent solution was used to characterize with TEM ）

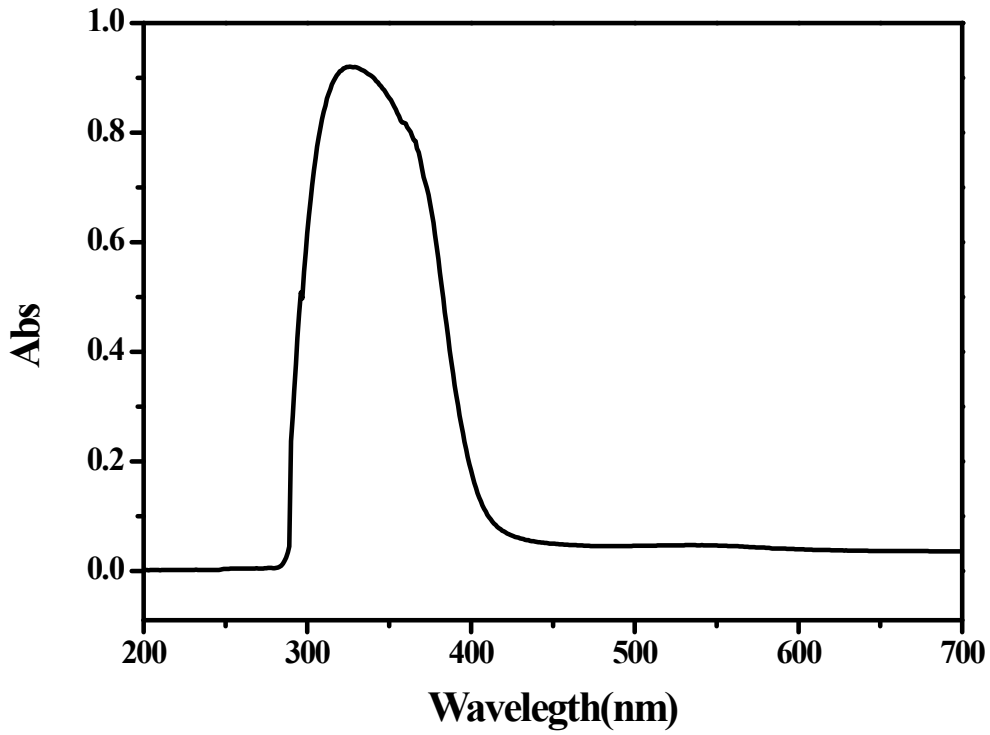

Fig.S5 The UV-visible absorption spectrum of the Si QDs dispersed in water

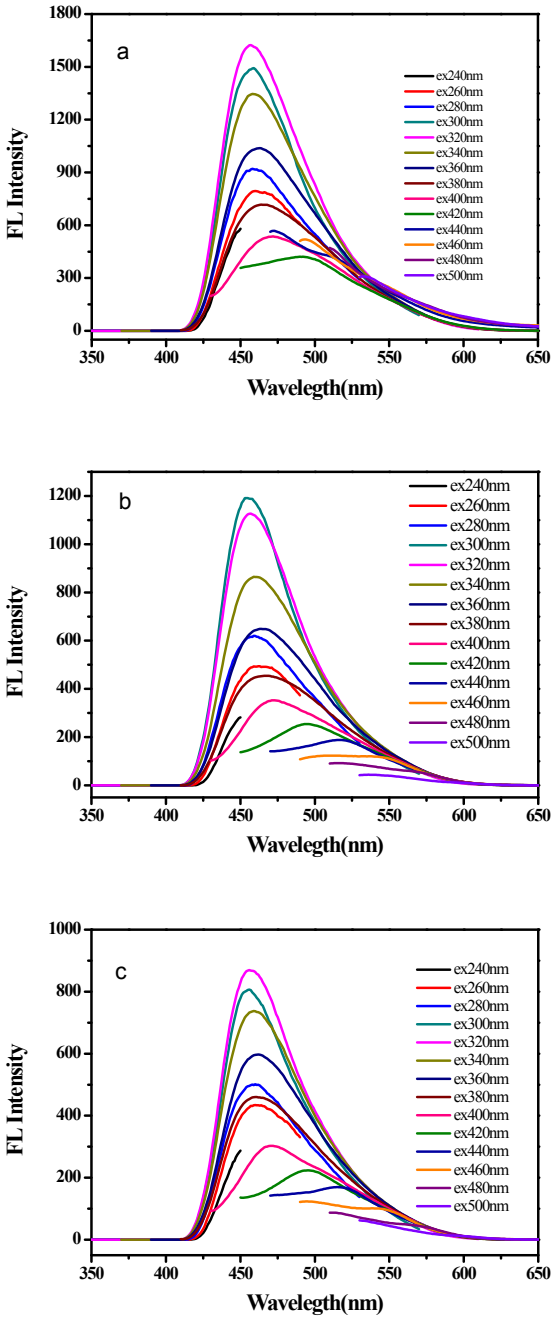

Fig. S6 The photoluminescence spectra of the Si QDs dispersed in water prepared with etching Si powder for different time at 200 ℃ (The etching time is 4, 6 and 8 h in a, b and c respectively)

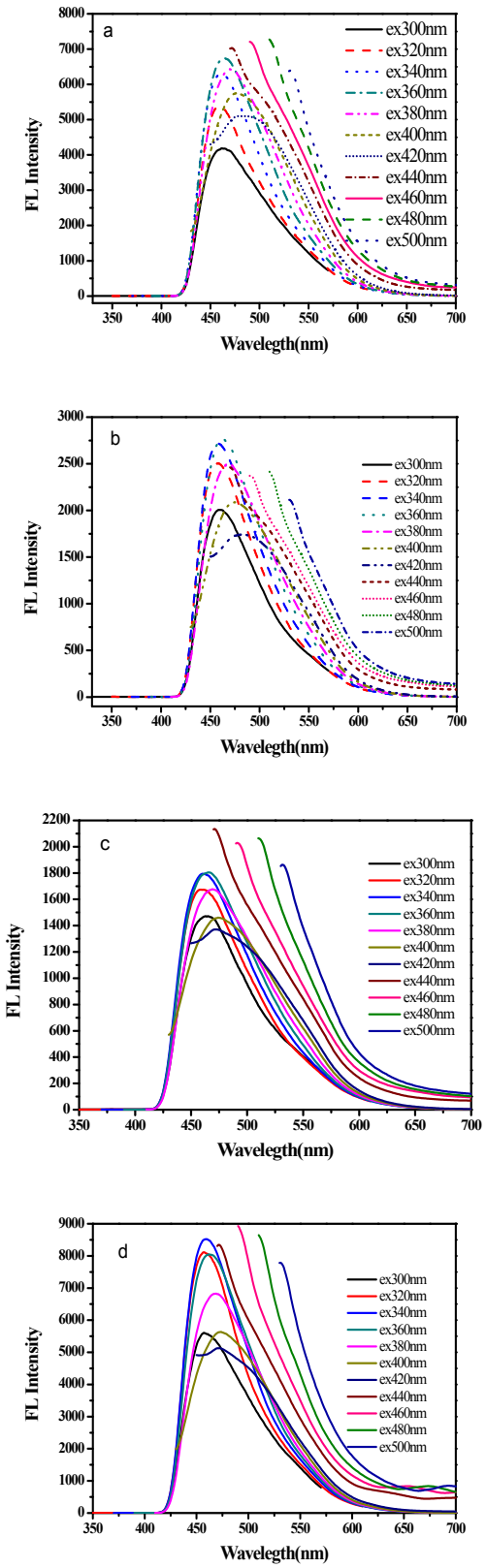

Fig. S7 The photoluminescence spectra of the solid powder of the Si QDs prepared with etching Si powder for different time at 200 ℃(The etching time is2, 4, 6 and 8 h in a, b, c and drespectively)

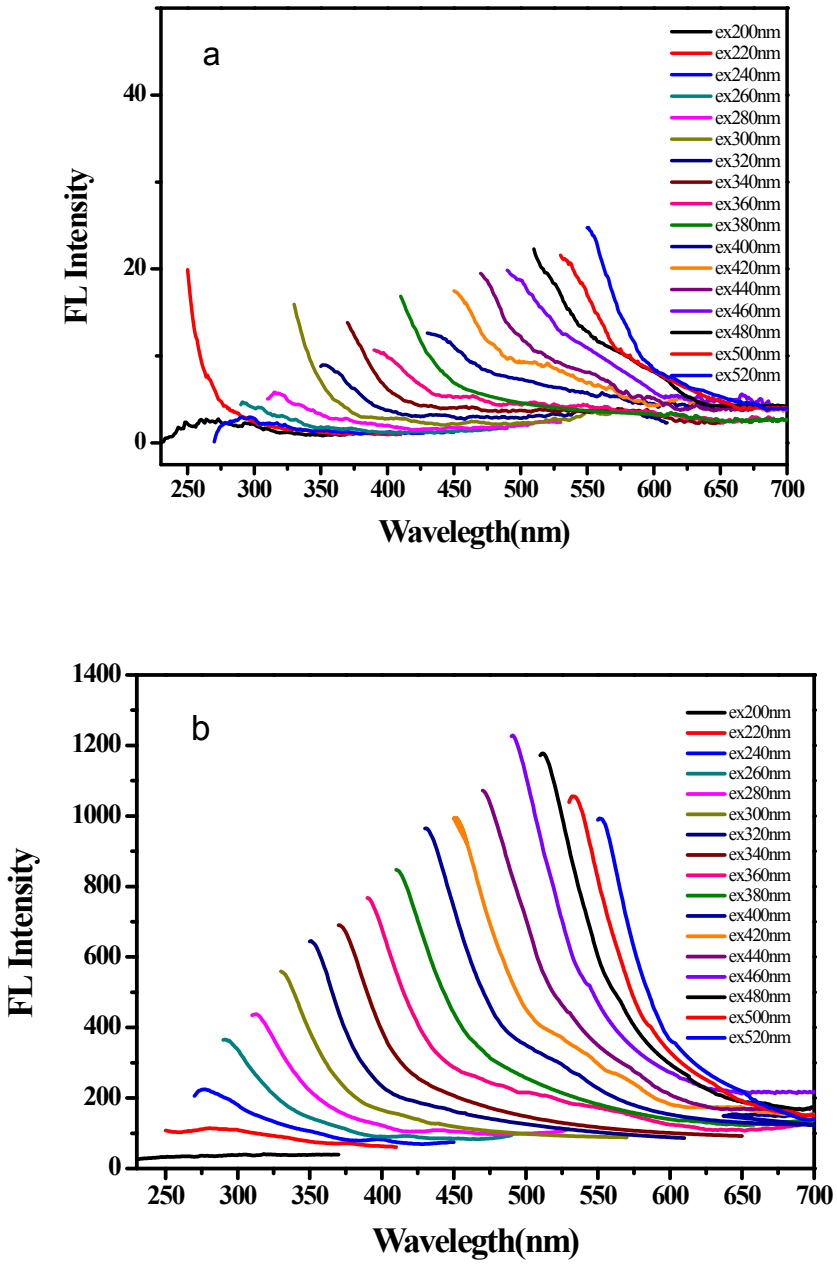

Fig. S8 The fluorescence spectra of the pristine Si powder dispersed in water (a) and in solid state (b)

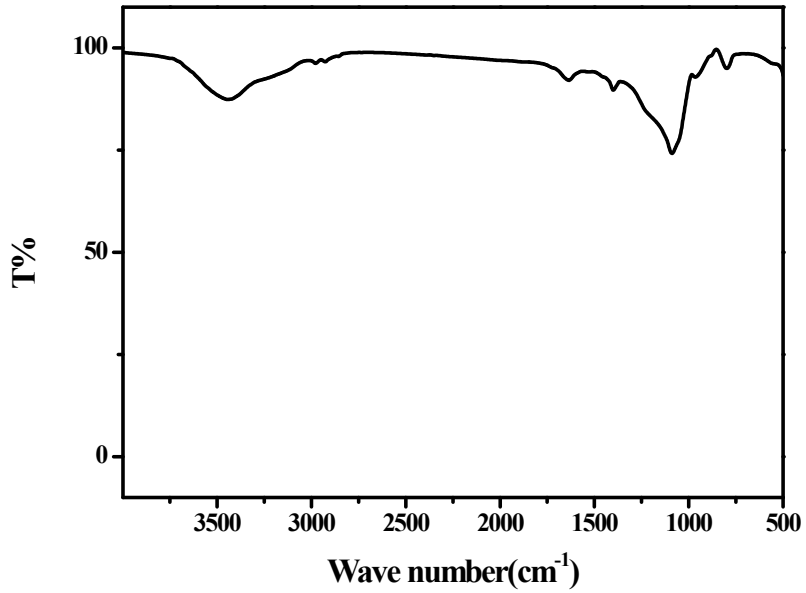

Fig. S9 The FTIR spectrum of Si QDs

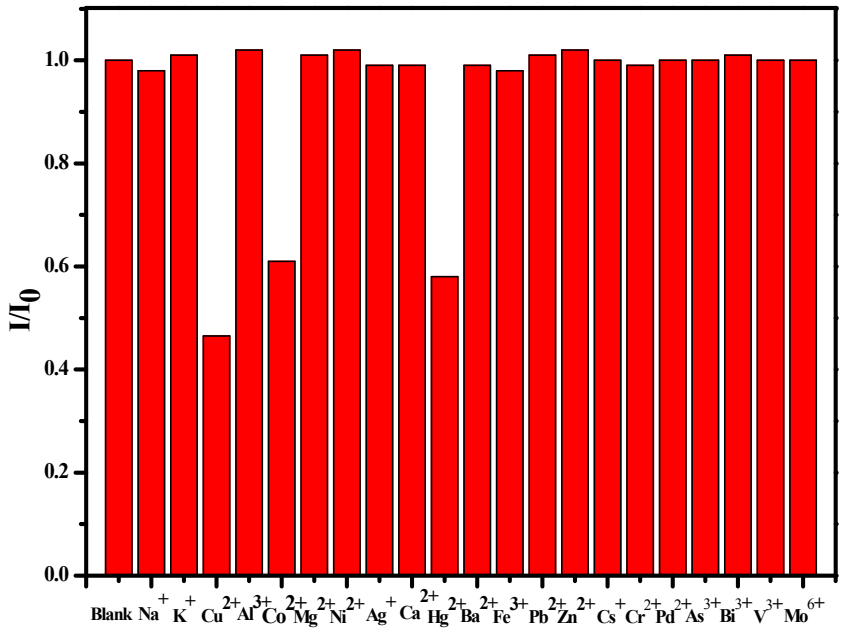

Fig. S10 The relative fluorescent emission intensity at 460 nm of the Si QDs in the presence of different metal cations (the concentration of the metal cation is 10^{-4}M) dispersed in water at pH of 7 without phytic acid