**Nanosensors based on structural memory carbon nanodots for Ag+ fluorescence determination**

Xi Zhou 123, Yufeng Cao 1, Xinji Zhou 1, Lina Xu 23, Daihui Zhang 23, Chunpeng Wang 23, Fuxiang Chu 23,\* , Tao Qian 1,\*

1 School of Chemistry and Chemical Engineering, Nantong University, Nantong 226019, China

2 Institute of Chemical Industry of Forestry Products, Chinese Academy of Forestry, Nanjing 210042, China

3 Co-Innovation Center of Efficient Processing and Utilization of Forest Resources, Nanjing Forestry University, Nanjing 210037, China

E-mail address: qiantao@ntu.edu.com (Qian Tao); chufxg@163.com (Fuxiang Chu)

**Cytotoxicity test**: Human uterine cancer cell (HeLa) was seeded into 96-well plates with Dulbecco's modified Eagle's medium (DMEM) for 24 h at a density of 104 cells/150 μL in an incubator (37 °C, 5% CO2). And the culture medium was replaced DMEM containing CSM-dots of different concentrations (0, 0.05, 0.1, 0.25, 0.5, 0.75 mg/mL) for another 24 h. Then, the cells were washed by 20 mL PBS buffer (pH 7.4) and incubated with MTT solution (5 mg/mL) for 4 h. After that, the culture medium was removed, followed by the addition of 150 μL DMSO and shaken for 10 min at room temperature. The optical density (OD) was measured by a microplate reader (ELx800, Biotek, USA) at 490 nm. The cell viability was estimated according to the following equation:

Cell viability (%) = (ODtreated/ ODcontrol) × 100%

where ODtreated was obtained in the presence of LGQDs, and ODcontrol was obtained in the absence of CSM-dots.

**Cellular imaging analysis**: The HeLa was first cultured in DMEM containing 10% fetal bovine serum (FBS) and 1% penicillin/streptomycin at 37 °C in 5% CO2 for 12 h, followed by incubation with CSM-dots (0.5 mg mL−1) for another 6 h. Then, the cells were washed with Dulbecco's phosphate buffer saline (DPBS) three times (1.0 mL each) to remove the CSM-dots. The Hela cells were harvest by fixed with 4% paraformaldehyde solution in DPBS at 4 °C for 30 min. The cellular imaging of the treated cells was performed on a Nikon Eclipse 90i microscope equipped with the Cool SNaP HQ2 CCD camera (Photometrics, AZ).



**Fig. S1** (a) The high-resolution XPS spectra of O 1s in CSM-dots. (b) TEM image of CSM-dots. (c) Size distribution of CSM-dots. (d) XRD pattern of CSM-dots.



**Fig. S2** The effect of different pH value on the FL performance of CSM-dots.



**Fig. S3** FL intensity variation of the CSM-dots as a function of temperature (a) and concentrations of NaCl (b).

**Table S1** Comparison of the reported probe for Ag+ determination.

|  |  |  |  |
| --- | --- | --- | --- |
| **Precursor** | **Linear range (μM)** | **Detect limit (nM)** | **Ref.** |
| Pyrrolo[2,1-a]isoquinoline | 0-30 | 600 | [1] |
| 1,2,4-Triaminobenzene | 0-30 | 660 | [2] |
| Polyurethane foam | 0-6 | 2800 | [3] |
| azidoimidizole | 0-20 | 480 | [4] |
| Bis(5,6-dimethylbenzimidazole) |  0-100 | 423 | [5] |
| Lignin | 5-290 | 500 | This work |



**Fig. S4** (a) FL decay spectra of CSM-dots and CSM-dots/Ag+ system. (b) The TEM image of CSM-dots /Ag+ composites.



**Fig. S5** The fluorescence microscopy images of HeLa cells treated with CSM-dots, (a) the bright-field images, (b) the fluorescent images, (c) the merged images of (a) and (b).

**References**

[1] Jiang, YL, Kong WW, Shen YM, Wang BX. Two fluorescence turn-on chemosensors based on pyrrolo[2,1-a]isoquinoline for detection of Ag+ in aqueous solution. Tetrahedron. 2015; 71(34):5584.

[2] Lu ZF, Su TT, Feng YT, Jiang SQ, Zhou CX, Hong PZ, Sun SL, Li CY. Potential application of nitrogen-doped carbon quantum dots synthesized by a solvothermal method for detecting silver ions in food packaging. Int J Env Res Pub He. 2019; 16(14):2518.

[3] Shen C, Ge SY, Pang YY, Xi FN, Liu JY, Dong XP, Chen P. Facile and scalable preparation of highly luminescent N, S co-doped graphene quantum dots and their application for parallel detection of multiple metal ions. J Mater Chem B. 2017; 5:6593.

[4] Wu ZS, Feng MK, Chen XX, Tang XJ. N-dots as a photoluminescent probe for the rapid and selective detection of Hg2+ and Ag+ in aqueous solution. J Mater Chem B. 2016; 4:2086.

[5] Wu YC, Jiang K, Luo SH, Cao L, Wu HQ, Wang ZY. Novel dual-functional fluorescent sensors based on bis(5,6-dimethylbenzimidazole) derivatives for distinguishing of Ag+ and Fe3+ in semi-aqueous medium. Spectrochim Acta A. 2019; 206: 632.