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Supporting information

Facile synthesis of orange emissive carbon dots and application for mercury ion detection and fast fingerprint development

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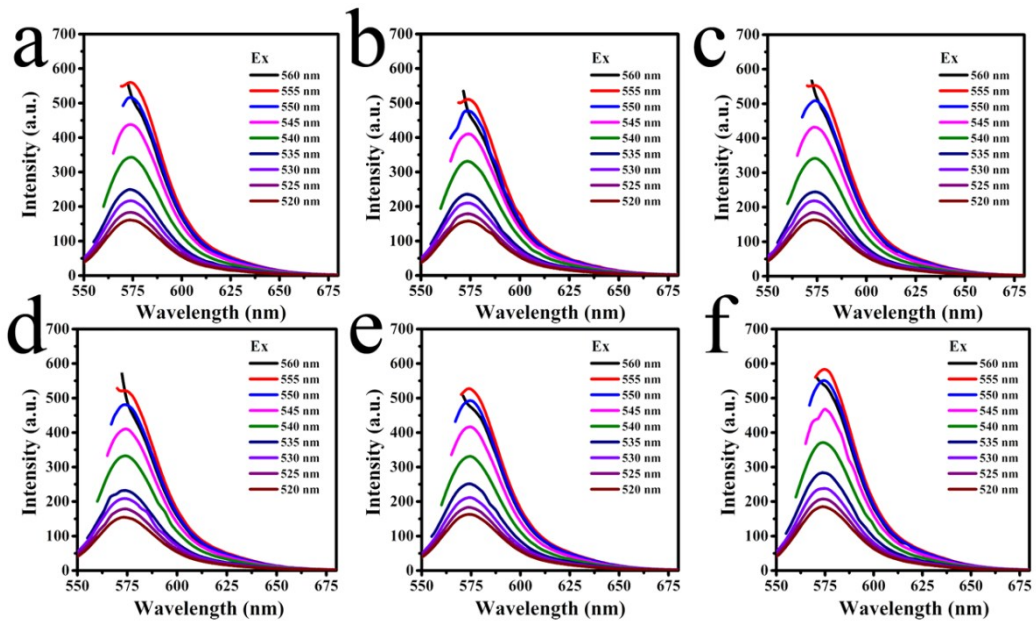

Fig. S1. The fluorescence spectra of the CDs synthesized under different condition (a) 120 °C 2 h, (b) 140 °C 2 h, (c) 160 °C 4 h, (d) 160 °C 6 h, (e) 180 °C 2 h, (f) 200 °C 2 h.

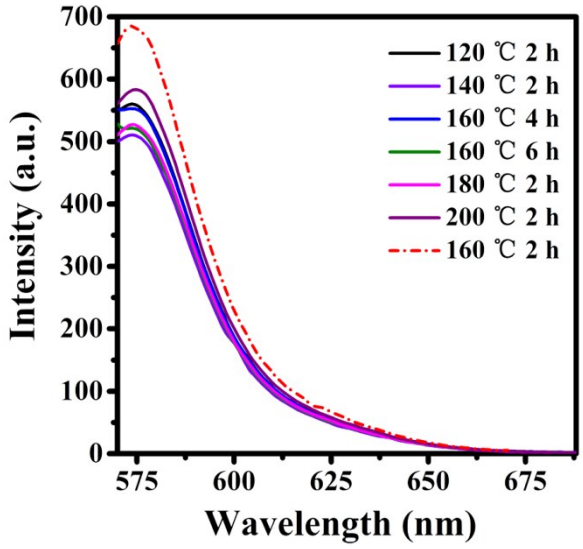

Fig. S2. The fluorescence spectrum excited by 555 nm of the CDs synthesized under different condition

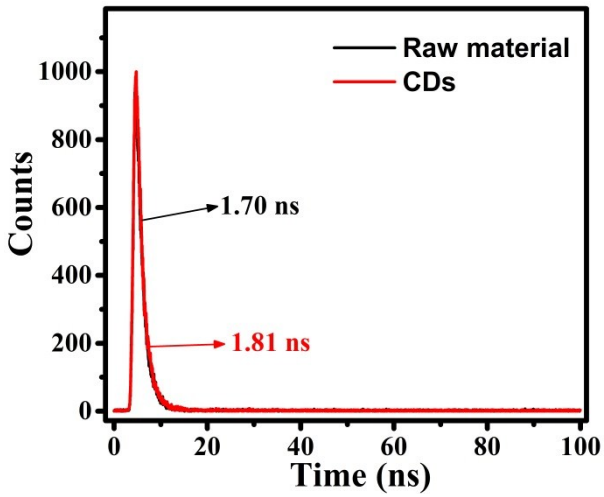

Fig. S3. Decay curves of the CDs and raw material.

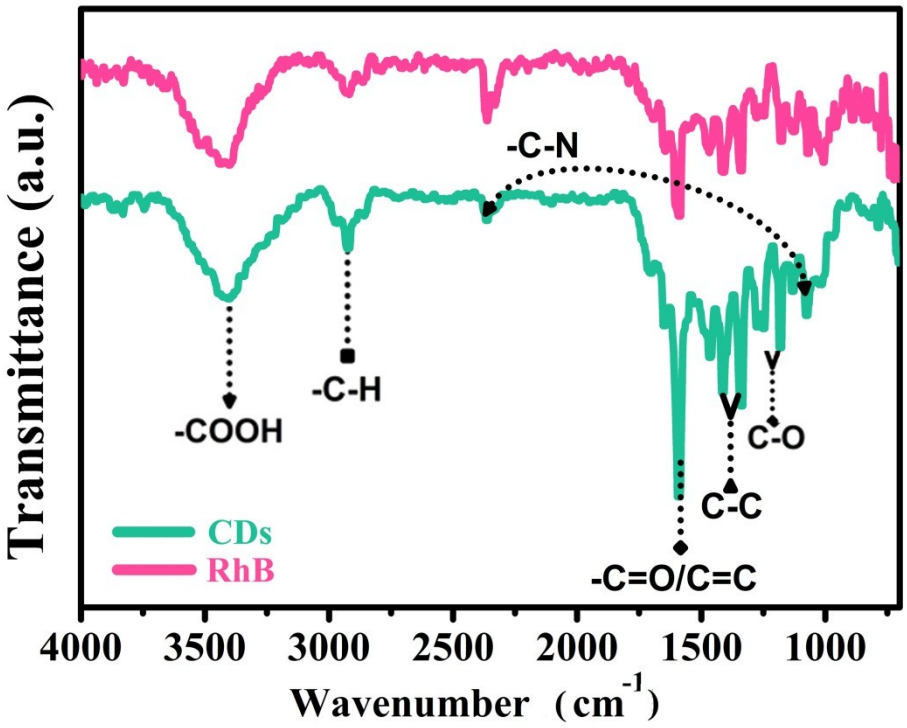

Fig. S4. FT-IR spectrum of the CDs and RhB

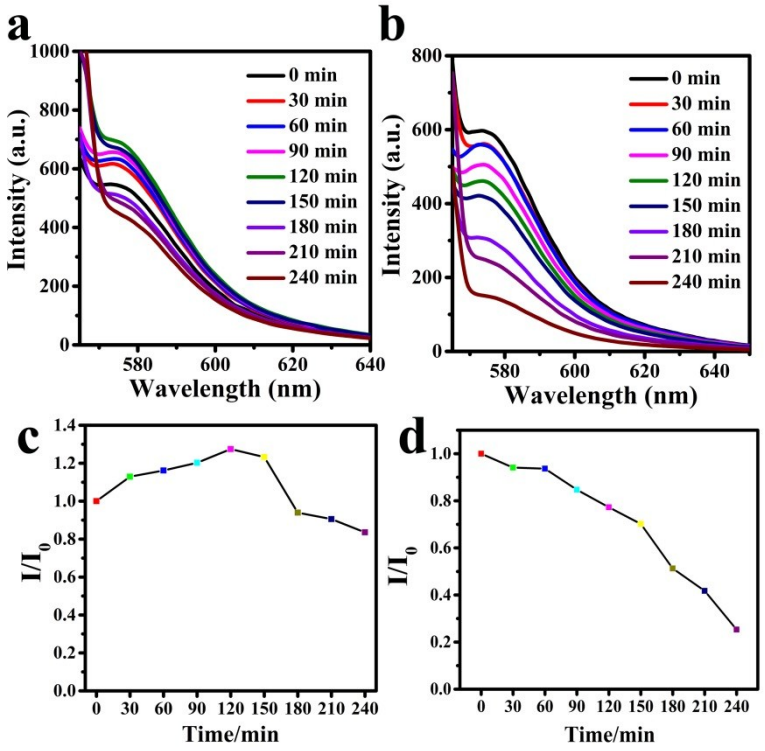

Fig. S5. (a) and (b) fluorescence spectrum of the CDs and RhB after different time period ultraviolet radiation, (c) and (d) fluorescence intensity fold line of he CDs and RhB after different time period ultraviolet radiation

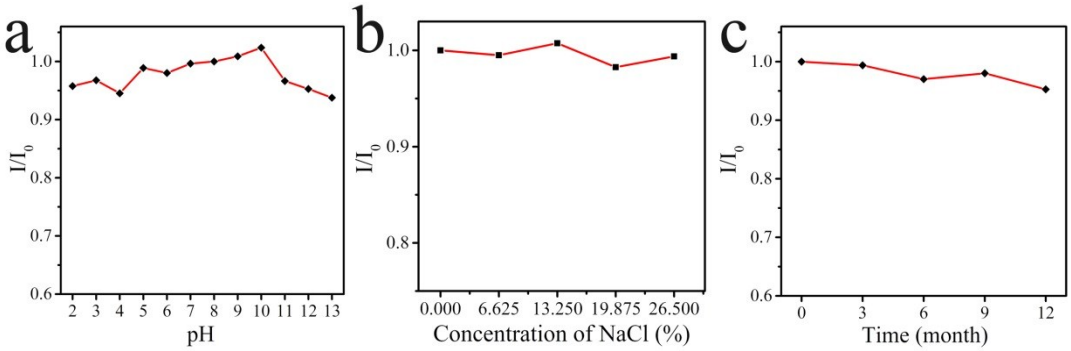

Fig. S6. Fluorescence intensity of CDs under (a) day light different period of time, (b) NaCl solutions, and (c) pH value.

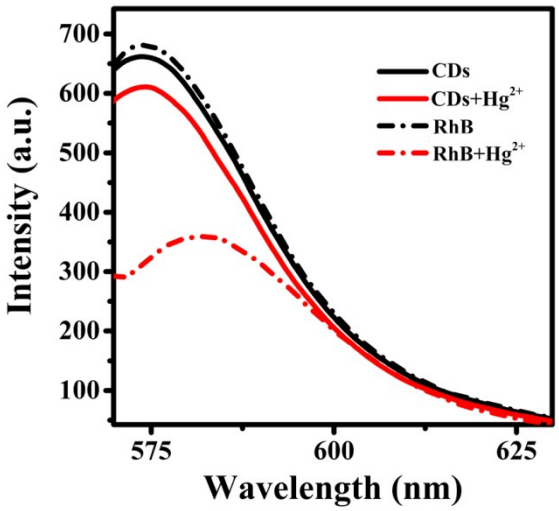

Fig. S7. The sensing ability comparison of the raw materials and CDs.

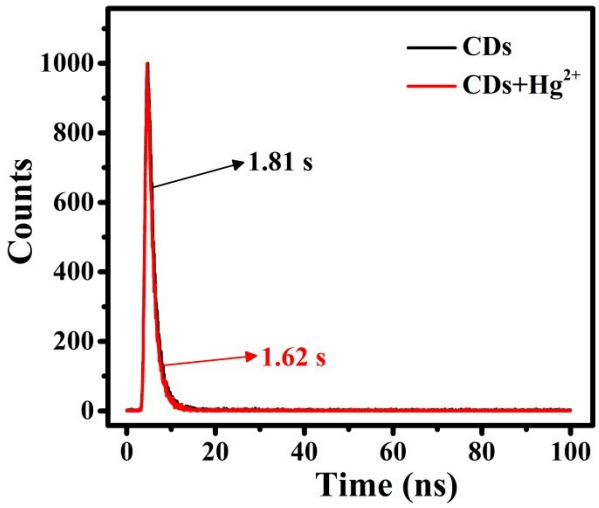

Fig. S8. Decay curves of the CDs with the absence and presence of 100 μM Hg^{2+} under the excitation of 555 nm and emission at 574 nm.

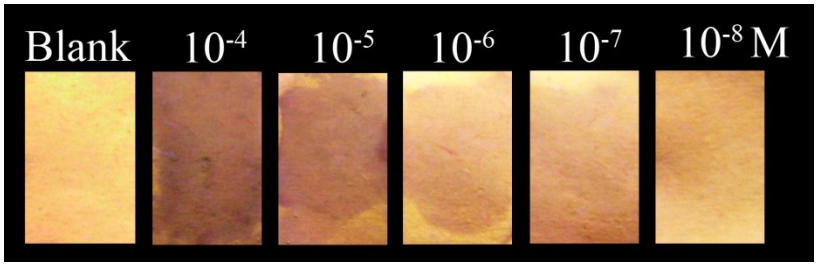

Fig. S9. Corresponding ultra-pure water sensitivity experiment of the test

papers photo under the UV light, the concentrations of the Hg^{2+} were chosen from 10^{-8} to 10^{-4} μM.

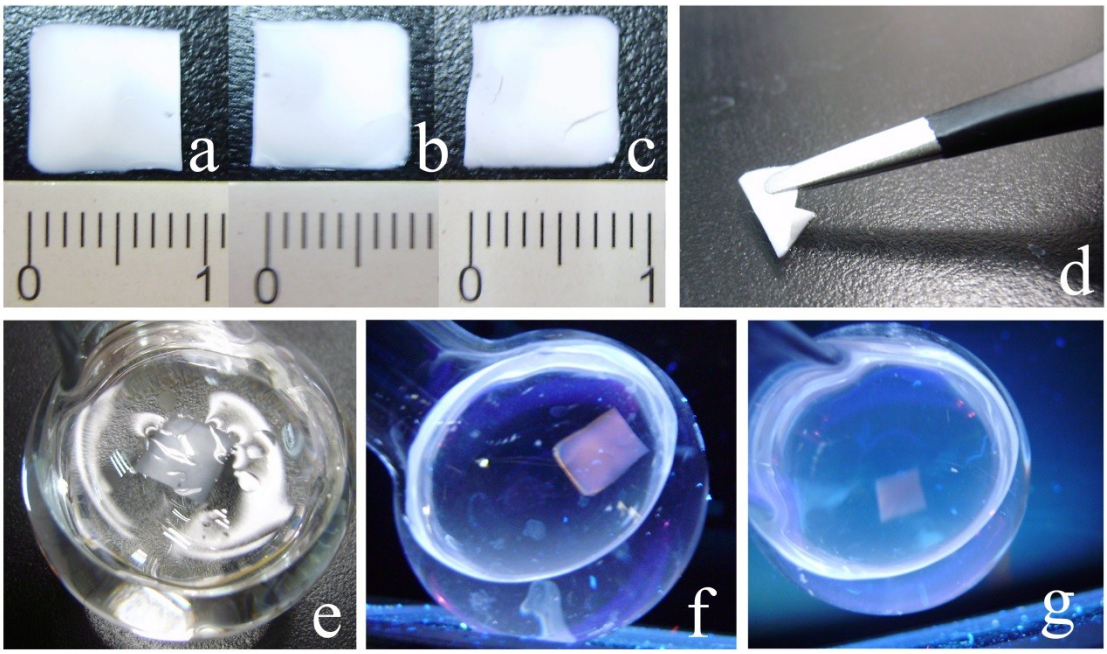

Fig. S10. The images of the CDs based film (a) just-prepared, (b) dipped in water for 10 min, (c) dipped in water for 60 min. (d) The films could be easily bent by tweezers. (e) The film dipped in water in day light. (f) The film dipped in water under UV light. (g) The film dipped in the solution which containing Hg^{2+} in 150 μM under UV light.

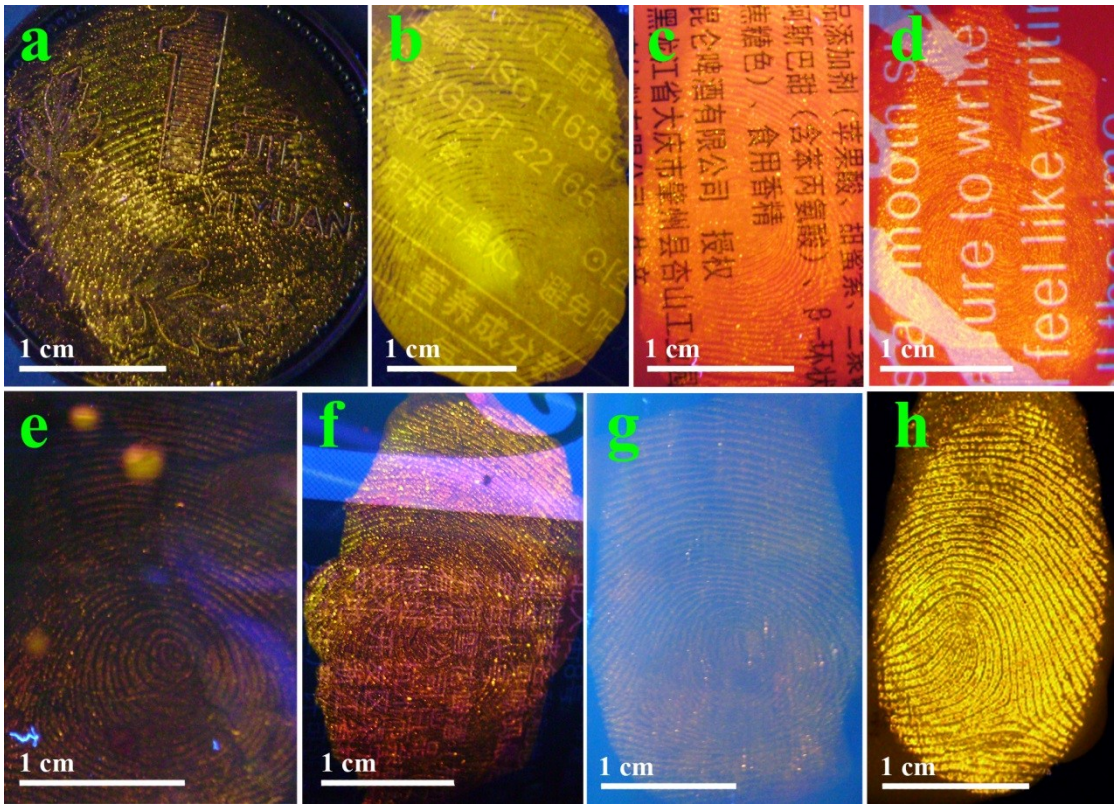

Fig. S11. Images of LFPs developed by CDs solution on (a) coin, (b) plastic food package, (c) soft drink paper packaging, (d) semi-porous surfaces of cardboard, (e) meter glass, (f) beer cans, (g) CD and (h) tape.

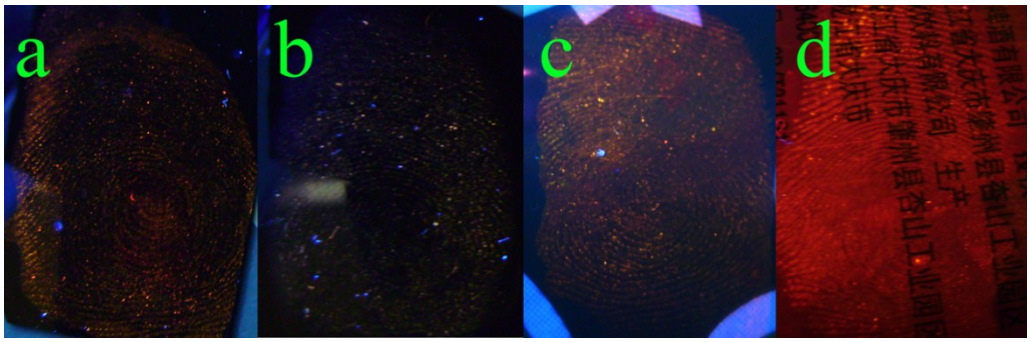

Fig. S12. (a) Developed images deposited on silicon wafer for 1 day, (b) Developed images deposited on silicon wafer for 7 days, LFPs developed by CDs solution on(c) beer cans, (d) soft drink paper packaging.

MTT Assay: HepG-2 cells were seeded into 96-well plates at a density of 1×10^4 per well in 100 μL of medium and and cultivated at 37°C overnight. Then the culture medium was replaced with medium contain different contents of CDs and then incubated at 37°C for 24 h. After that, the culture medium was removed and 20 μL of 0.5 mg/mL MTT was added into each well. After incubation for 4 h, the MTT was washed three times with PBS, and then 100 μL of DMSO was added into each well and shaken for 10 min to fully dissolve the MTT. Lastly, the optical density of each sample was recorded using a microplate reader (Bio-TekELx800) at a wavelength of 490 nm.

Cell Culture: HepG-2 cells were seeded in 6-well plates by Dulbecco's Modified Eagle's Medium (DMEM) with 10% fetal bovine serum (FBS), 1% penicillin and streptomycin at 37°C for 24 h. Then, the prior culture medium was discarded and 0.5 mL of DMEM containing 10% FBS and 0.0417 g/L CDs were added into the well and cultivated for 2 and 6 h at 37°C. Finally, the cells were washed three times with PBS and fixed with 2.5% glutaraldehyde for 10 min. Then the cells were washed three with PBS and fixed with 2.5% glutaraldehyde for 10 min. The cells were then imaged under a Leica DM IL LED Fluorescence inverted microscope (FIM).

The QY of the CDs was determined by a typical recognized process. As a rule, quinine sulfate in 0.1 M H_2SO_4 aqueous solution was chosen to be

the reference (QY is 54% at 340nm). In order to abate the reabsorption effects, the solution of reference sample and CDs were always diluted to keep the absorbance under below 0.1, respectively. The QY of the CDs is calculated following the equation below:

$$Q_{CDs} = Q_R \left(\frac{Grad_{CDs}}{Grad_R} \right) \left(\frac{\eta_{CDs}^2}{\eta_R^2} \right)$$

where subscripts R refers to quinine sulfate and CDs, Q refers to the QY, Grad represents the gradient from the plot of integrated FL intensity / absorbance, and η is the refractive index of the solvent (η_{water}: 1.33).

Supporting Information. Brief statement in nonsentence format listing the contents of the material supplied as Supporting Information.

Table S1 Comparison between the proposed method and other methods for the detection of Hg^{2+}.

Methods	Probe type	LOD (M)	Ref.
Au/N-doped carbon quantum dots	**Fluorescence**	**1.18×10^{-7}**	**[1]**
N-Doped Carbon Dots	**Fluorescence**	**2.0×10^{-8}**	**[2]**
Magnetic fluorescent nanoparticles	**Fluorescence**	**1.24×10^{-8}**	**[3]**

Organic-inorganic perovskite	**Fluorescence**	**2.40×10^{-6}**	**[4]**
Carbon dots	**Fluorescence**	**2.20×10^{-9}**	**[5]**
hemin-graphene	**Colourmetric**	**3.30×10^{-11}**	**[6]**
MoS 2 -Au composites	**Fluorescence**	**5.00×10^{-9}**	**[7]**
Graphene quantum dots and poly(5-formylindole) nanocomposite	**electrochemiluminescence**	**2.48×10^{-12}**	**[8]**
Carbon dots	**Fluorescence**	**2.47×10^{-9}**	**This work**

Reference:

[1] Alan Meng, Qinhai Xu, Kun Zhao, Zhenjiang Li, Jun Liang, Qingdang Li. A highly selective and sensitive “on-off-on” fluorescent probe for detecting Hg(II) based on Au/N-doped carbon quantum dots. Sens. Actuators B Chem. 2018, 255, 657. DOI: http://dx.doi.org/10.1016/j.snb.2017.08.028

[2] Anam Iqbal, Kanwal Iqbal, Lige Xu, Bo Li, Deyan Gong, Xiaoyu Liu, Yali Guo, Weisheng Liu, Wenwu Qin, Huichen Guo. Heterogeneous synthesis of nitrogen-doped carbon dots prepared via anhydrous citric acid and melamine for selective and sensitive turn on-off-on detection of Hg (II), glutathione and its cellular imaging. Sens. Actuators B Chem. 2018, 255, 1130. DOI: http://dx.doi.org/10.1016/j.snb.2017.08.130

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[4] Yicun Huang, Fanyong Yan, Jinxia Xu, Yuyao Bian, Ruiqi Zhang, Jie Wang. Xuguang Zhou. The FRET performance and aggregation-induced emission of two-dimensional organic-inorganic perovskite, and its application to the determination of Hg(II). *Microchimica Acta,* 2017, **184**, 3513. DOI: 10.1007/s00604-017-2360-7

[5] Functional preserving carbon dots-based fluorescent probe for mercury (II) ions sensing in herbal medicines via coordination and electron transfer. Hui, He Jia , et al. "Functional preserving carbon dots-based fluorescent probe for mercury (II) ions sensing in herbal medicines via coordination and electron transfer." *Analytica Chimica Acta,* 2018, **1035**, 203. DOI: 10.1016/j.aca.2018.06.053

[6] Pengxi Deng, Shuang Zheng, Wen Yun, Weilu Zhang, Lizhu Yang. A visual and sensitive Hg 2+ detection strategy based on split DNAzyme amplification and peroxidase-like activity of hemin-graphene composites. *Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy,* 2019, **210**, 335. DOI: 10.1016/j.saa.2018.11.048

[7] Chunmeng Ma, Yao Ma, Yifan Sun, Yuan Lu, Enlin Tian, Jingfeng Lan, Jialu Li, Weichun Ye, Haixia Zhang. Colorimetric determination of

Hg^{2+} in environmental water based on the Hg^{2+} -stimulated peroxidase mimetic activity of MoS2-Au composites. Journal of Colloid and Interface Science, 2019, 537, 554. DOI: 10.1016/j.jcis.2018.11.069