

Supporting Information

**Magnetic perovskite nanocrystals for latent fingerprint detection**

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## Experimental Section

**Chemicals.** Oleylamine (80-90%, OLA), oleic acid (85%, OA), iron chloride hexahydrate (99%,  $\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$ ), sodium hydroxide (98%, NaOH), ammonia solution (28-30%,  $\text{NH}_3 \cdot \text{H}_2\text{O}$ ) and tetraethyl orthosilicate (98%, TEOS) were obtained from Aladdin. Octadecene (90%, ODE) and (3-aminopropyl)triethoxysilane (99.9%, APTES) were obtained from Alfa Aesar. Cesium carbonate (99.9%,  $\text{Cs}_2\text{CO}_3$ ) was obtained from Amethyst Chemicals. Lead bromide (99%,  $\text{PbBr}_2$ ) was obtained from Macklin. Igepal CO-520 was obtained from Aldrich. Hexane (99.5%), ethanol (99.5%), methanol (99.5%) and cyclohexane (99.5%) were purchased from Kermel. All the chemicals could be used directly without any purification or treatment.

### Synthesis of $\text{Fe}_3\text{O}_4$ NPs.

#### 1. Preparation of $\text{Fe}(\text{oleate})_3$

20 mmol  $\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$  and 20 mL oleic acid were added into 100 mL methanol. Next, a NaOH solution was formed by adding 60 mmol NaOH in 200 mL methanol. Then, these two solutions were mixed together and stirred for 12 hours. The red-brown precipitate was formed and washed with methanol 4-5 times. Finally, the precipitate was dried under vacuum for 12 hours to remove all solvents.

#### 2. Synthesis of $\text{Fe}_3\text{O}_4$ NPs by high temperature thermal decomposition method

In a typical synthesis, 1.2 g red-brown-colored solid was added into 10 mL ODE at  $80^\circ\text{C}$ . Then, 0.2 mL OA was added into the solution and the mixture was heated to  $300^\circ\text{C}$  under a nitrogen atmosphere. 30 min later, the reaction was stopped. Methanol/ethanol was added into the flask to precipitate nanoparticles and the precipitate was collected after centrifugation. Then, the precipitate was redispersed in cyclohexane. The  $\text{Fe}_3\text{O}_4$  NPs is obtained by purified 3 times.

### Synthesis of $\text{Fe}_3\text{O}_4@\text{SiO}_2$ NPs.

In a typical process, 8 mL Igepal CO-520 was dispersed in 170 mL cyclohexane in a 250 mL flask and stirred for 1 hour. Subsequently, 10 mL  $\text{Fe}_3\text{O}_4$ -cyclohexane solution (10 mg/mL) was injected into the flask. Then, 1.5 mL ammonia was dropped into the mixture. Next, the flask was sealed and stirred for 10 min. 2.5 mL TEOS was added into the flask at an injecting rate of 1 mL/h by using a Syringe Pump (TS-1B,

LONGER). After that, the mixture was sealed and stirred for three days at room temperature. 50 mL methanol was added into the solution to collect the particles. The particles were washed with excess hexane and collected by centrifugation. Then the particles were redispersed in ethanol, precipitated with excess hexane, and collected by centrifugation. The  $\text{Fe}_3\text{O}_4@\text{SiO}_2$  particles were purified three times to remove excess Igepal CO-520 and dispersed in ethanol at last.

#### **Synthesis of $\text{Fe}_3\text{O}_4@\text{SiO}_2\text{-NH}_2$ NPs.**

0.6g  $\text{Fe}_3\text{O}_4@\text{SiO}_2$  was dispersed in 10 mL ethanol. Then 1 mL APTES was added into the solution and stirred for 6 hours at room temperature. The product was obtained by centrifugation, and was dispersed in 10 mL ethanol again.

#### **Preparation of Cs-oleate.**

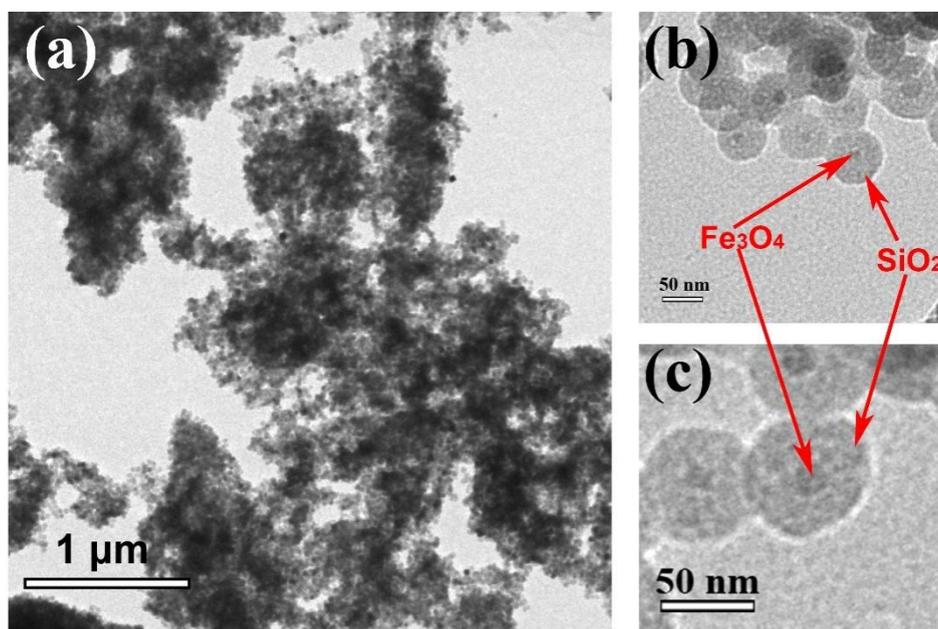
2.5 mmol  $\text{Cs}_2\text{CO}_3$ , 2.5 mL OA and 40 mL ODE was loaded into 50 mL three-neck flask and dried for 1h at 120 °C. Then the flask was heated to 150 °C under  $\text{N}_2$  until all  $\text{Cs}_2\text{CO}_3$  was dissolved.

#### **Synthesis of $\text{Fe}_3\text{O}_4@\text{SiO}_2\text{-CsPbBr}_3$ NPs.**

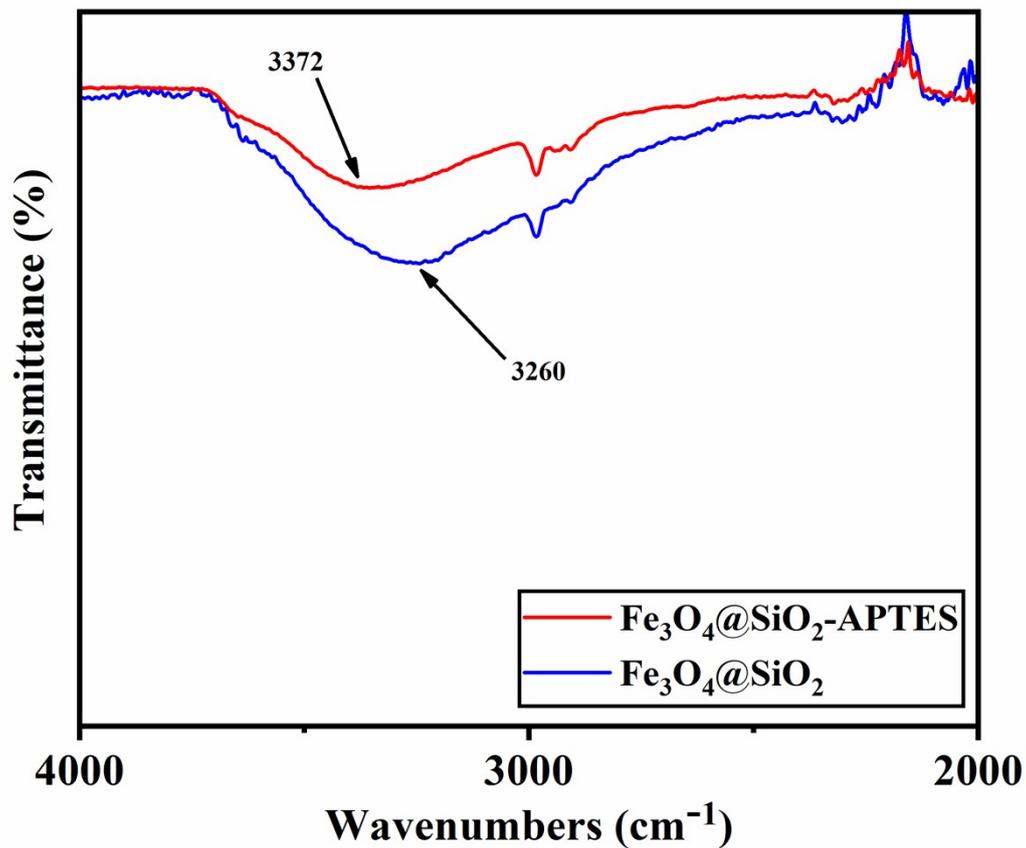
10 mL  $\text{Fe}_3\text{O}_4@\text{SiO}_2\text{-NH}_2$  ethanol solution and 10 mL ODE was added into a 100 mL three-necked flask. Then the flask was heated to 120 °C under vacuum for 2 h to remove the ethanol. The mixture was cooled to room temperature and 0.2 mmol  $\text{PbBr}_2$ , 0.5 mL OLA and 1 mL OA were added into the flask. The flask was raised to 120°C again and kept for 2 h under vacuum. Then, the flask was heated to 140°C under nitrogen and 0.42 mL Cs-oleate was quickly injected. The flask was immediately cooled by water bath. Finally, a magnet was used to collect the product.

**Measurement and Characterization:** The photoluminescence (PL) spectra were obtained by a GANGDONG F-320 fluorescence spectrometer. X-ray diffraction (XRD) patterns of all powders were measured by a Bruker D8 ADVANCE X-ray diffractometer (Cu  $\text{K}\alpha$ :  $\lambda = 1.5406 \text{ \AA}$ ). Fourier transform infrared (FTIR) spectroscopy was recorded on a Thermo-Nicole iS50 FTIR spectrometer. Absorbance spectra of samples were measured by Shimadzu UV-3600. The absolute PLQYs of the samples

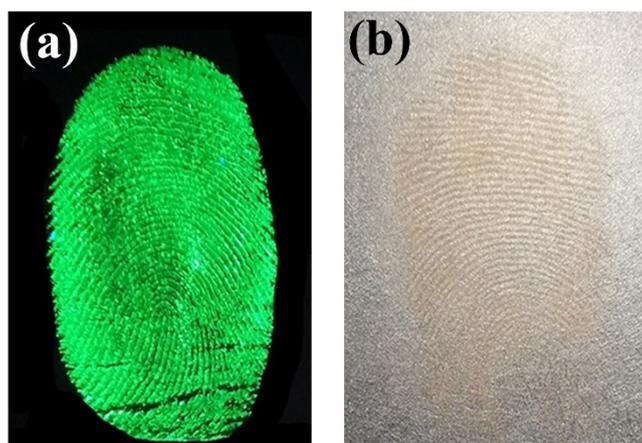
were measured by a PLQY spectrometer (absolute PLQY spectrometer QE PRO, Ocean Optics). The clear three-level fingerprint picture was taken by an electron optical microscope (DSX510, OLYMPUS). Transmission Electron Microscope (TEM) images of all samples were made by FEI Talos F200X, and the instrument model of the Energy-dispersive X-ray spectroscopy (EDX) test of the sample was Oxford X-ray spectrometer. The Zeta potential test was obtained by a laser particle size analyzer (SURPASS 3, Anton Paar GmbH).



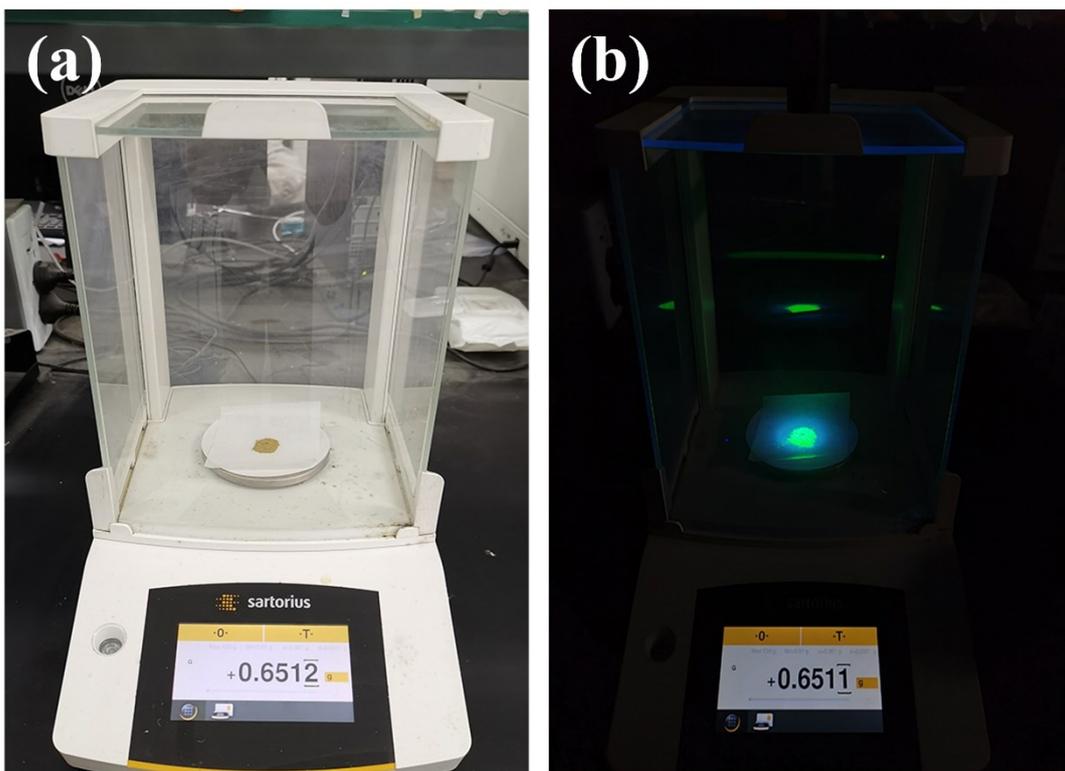
**Figure S1.** TEM images of  $\text{Fe}_3\text{O}_4@\text{SiO}_2$  under different magnifications.



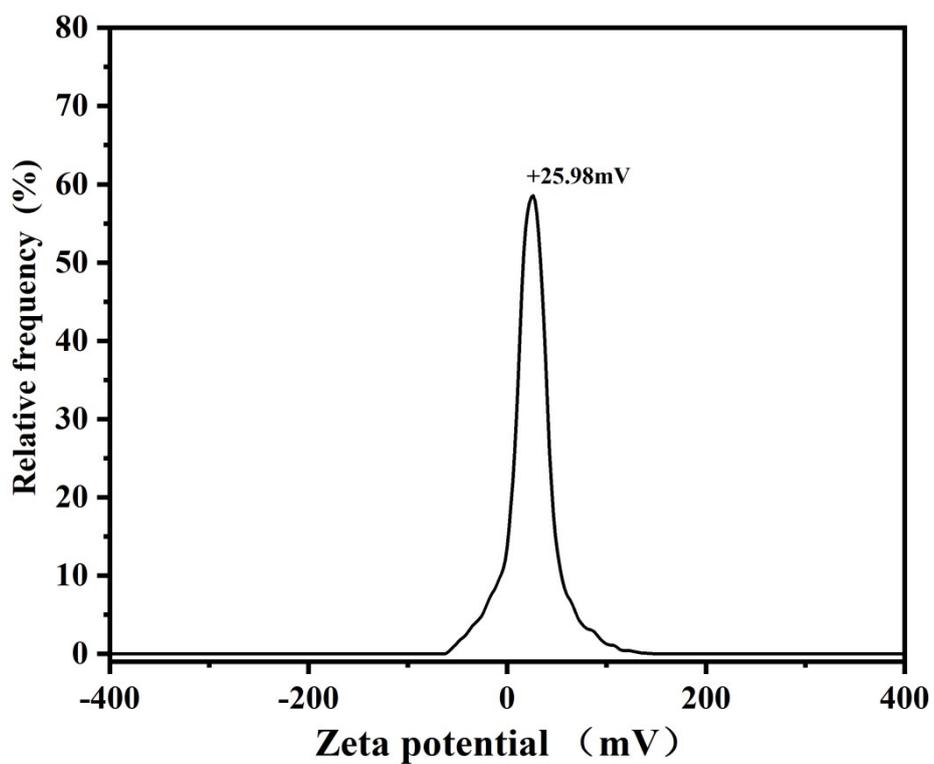
**Figure S2.** Partially enlarged Fourier transform infrared (FTIR) spectra of Fe<sub>3</sub>O<sub>4</sub>@SiO<sub>2</sub> NPs and Fe<sub>3</sub>O<sub>4</sub>@SiO<sub>2</sub>-APTES NPs.



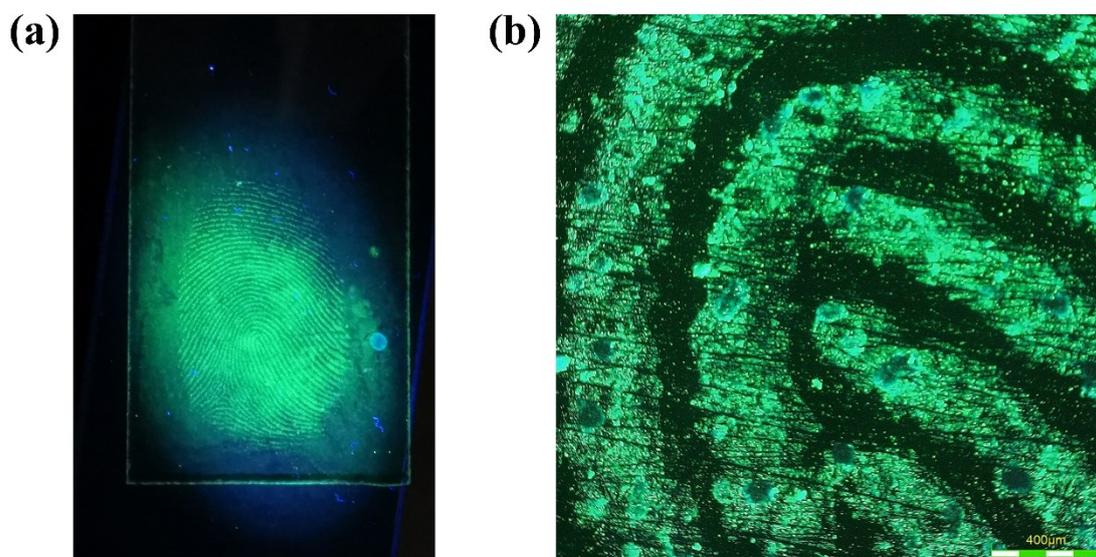
**Figure S3.** (a) Fingerprints produced by pure CsPbBr<sub>3</sub> under 365 nm ultraviolet (UV) light. (b) Fingerprints produced by magnetic iron oxide powder under natural light.



**Figure S4.** The photograph of the products on balance, under (a) natural light and (b) UV light.



**Figure S5.** The zeta potential of  $\text{Fe}_3\text{O}_4@\text{SiO}_2\text{-CsPbBr}_3$  NPs bifunctional powder.



**Figure S6.** (a) Fingerprint image acquired by using the dust blowing method. (b) Fingerprint image acquired by using soft feather brush.

As shown in Figure S6a, the excess nanomaterials cannot be completely removed by dust blowing method and some nanomaterials may retain on the margin of the fingerprints, resulting in a relatively low contrast and sharpness. Additionally, if a feather brush with a soft texture is used, the external abrasions can destroy or alter the developing fingerprints (Figure S6b). In order to avoid these problems, the magnetic-fluorescent powder is used here, where non-contact magnet can attract the excess powder, preserving the fingerprint details. The excess magnetic fluorescent powder will be attracted by magnet, and the collected powder can be reused, which can save costs.