Supporting Information

Halide Ion-mediated Synthesis of $L1_0$-FePt Nanoparticles with Tunable Magnetic Properties

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Supporting information including:

The Supporting Information is available free of charge on the ACS Publications website, and includes experiment section, TEM images, XRD patterns and hysteresis

loops (Figures S1-S12).

Experimental details

Materials. Platinum (II) acetylacetonate ($Pt(acac)_2$, 97%), potassium hexachloroplatinate (VI) (K_2PtCl_6, 98%), iron (III) acetylacetonate ($Fe(acac)_3$, 98%), ammonium chloride (NH_4Cl, 99.99%), iron chloride tetrahydrate ($FeCl_2 \cdot 4H_2O$), ammonium persulfate ($(NH_4)_2SO_4$, ≥98%), potassium iodide (KI, 99.0%), potassium bromide (KBr, 99.0%), oleylamine (OAm, ＞70%), hexane (98.5%), ethanol (99.5%) and isopropyl alcohol (99.5%) were all purchased from Aladdin. All the chemicals and solvents were used as received without any purification.

Preparation of fcc-FePt nanoparticles (NPs). In the atmosphere of N_2, 0.2 mmol $Pt(acac)_2$, 0.2 mmol $Fe(acac)_3$ and 10 mL of OAm were mixed with magnetic stirring. The mixture was heated to 100 ^oC for 30 min to purify the reaction system. Then the reaction solution was heated to 350 ^oC for 3 h at a heating rate of 5 ^oC/min. The reaction mixture was precipitated by isopropyl alcohol and collected by centrifugation at 9000 rpm for 5 min, then washed with hexane/ethanol (the volume ratio is 1:3) mixture.

Preparation of fct-FePt nanoparticles (NPs). Fct-FePt NPs were prepared by the same method as described above in the preparation of fcc-FePt NPs other than adding NH_4Cl into the reaction mixture. Similarly, the reaction was also run in the presence

of KBr, or KI, respectively, to study the effects of different kinds of halide ions. Under the same reaction conditions, the $Fe(acac)_3$ was replaced by $FeCl_2 \cdot 4H_2O$, $Pt(acac)_2$ was replaced by K_2PtCl_6 to confirm that the Cl^- play a dominant part on the formation of fct FePt NPs.

Characterization. X-ray diffraction (XRD) patterns were collected on a PANanalytical X'Pert Powder with Cu Kαradiation (λ =1.5418 Å). Transmission electron microscopy (TEM) images were acquired on a JEM-1400 operating at 100 kV (JEOL Ltd). High-resolution TEM (HRTEM) images were obtained on a Talos F200X with an accelerating voltage of 200 kV. Magnetic properties were measured with a Lakeshore 7407 high sensitivity vibrating-sample magnetometer (VSM) with fields up to 3.0 T at room temperature. The compositions were analyzed by inductively coupled plasma atomic emission spectroscopy (ICP-AES). Scanning transmission electron microscopy (STEM) analyses were carried out on a Titan Cubed Themis 60-300 with a probe aberration corrector (resolution <0.059nm), at the National Center for Electron Microscopy in Beijing for Information Science and Technology.

Figure S1-S12

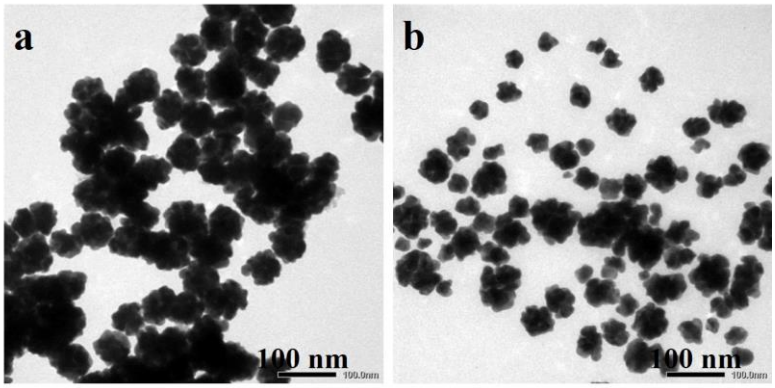

Figure S1. The TEM images of as-prepared FePt NPs (**a**) and ultrasonic treated FePt NPs (**b**) synthesized with a Cl^-/Pt^{2+} mole ratio of of 3:1 at 350 ^oC for 3 h.

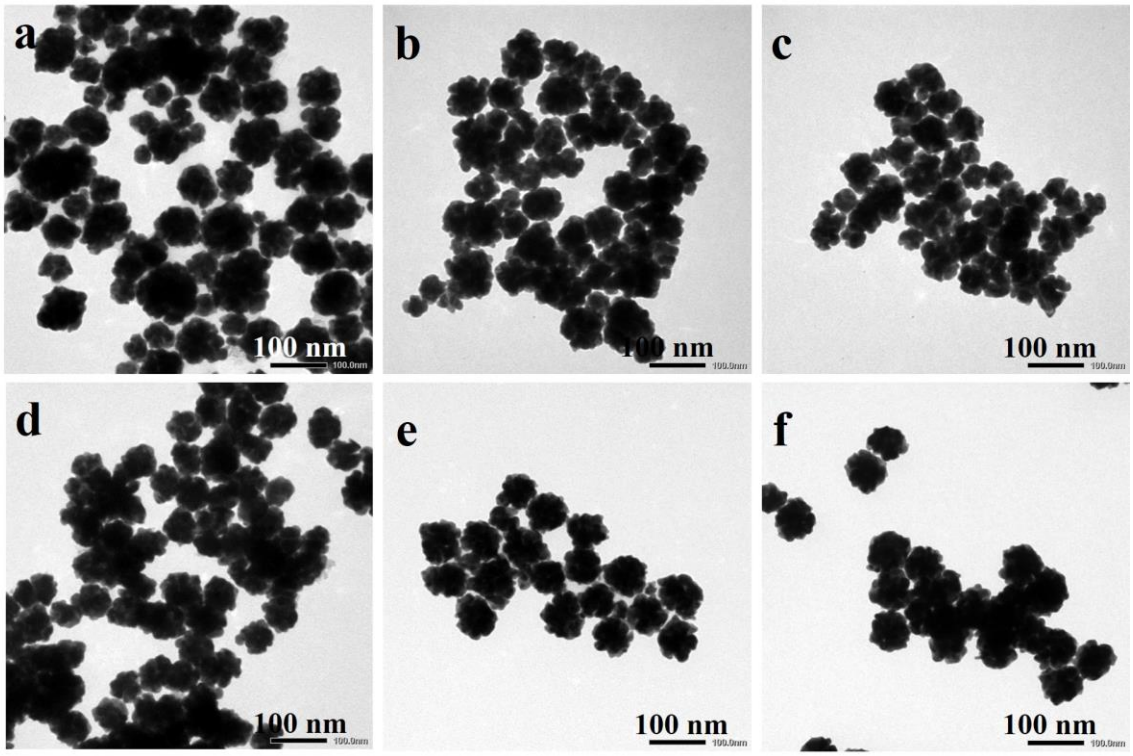

Figure S2. The TEM images of FePt NPs synthesized with a Cl^-/Pt^{2+} mole ratio of 3:1 at 350 ^oC for (**a**) 0.5 h, (**b**) 1 h (**c**) 2 h, (**d**) 3 h, (**e**) 6 h and (**f**) 9 h.

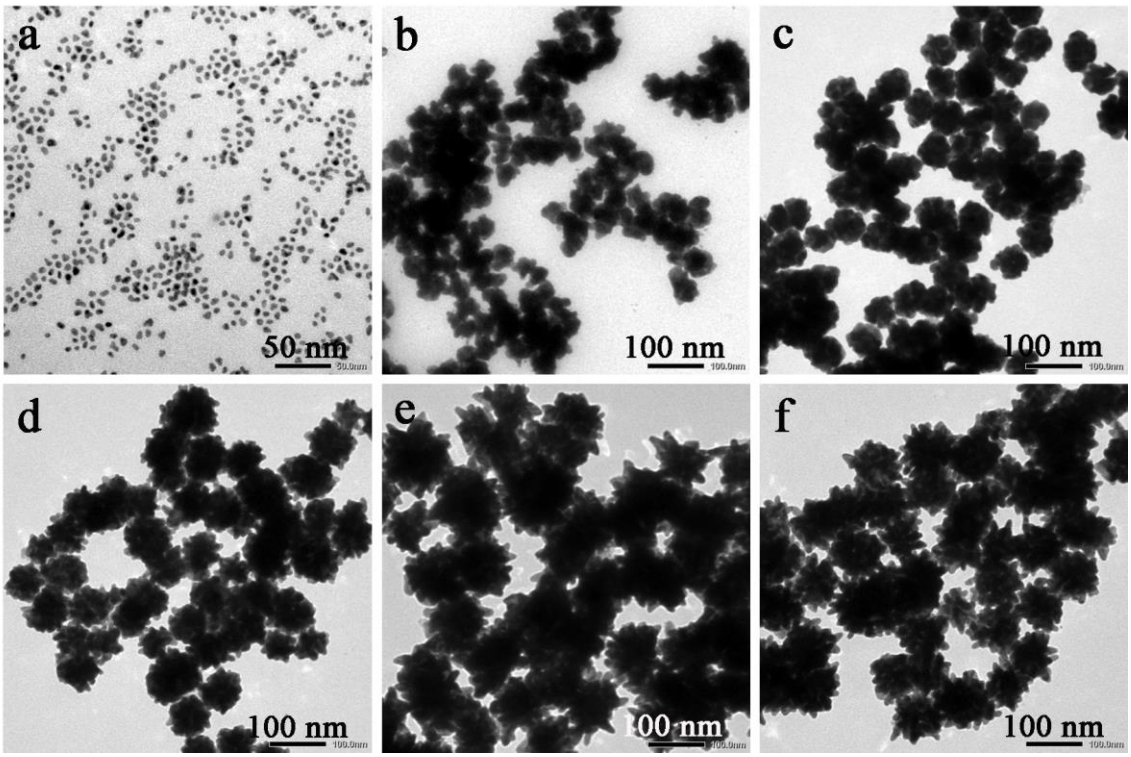

Figure S3. The TEM images of FePt NPs synthesized with a different Cl^-/ Pt^{2+} mole ratio at 350 ^oC for 3 h: (**a**) 0:1, (**b**) 2:1, (**c**) 3:1, (**d**) 4:1, (**e**) 5:1 and (**f**) 6:1.

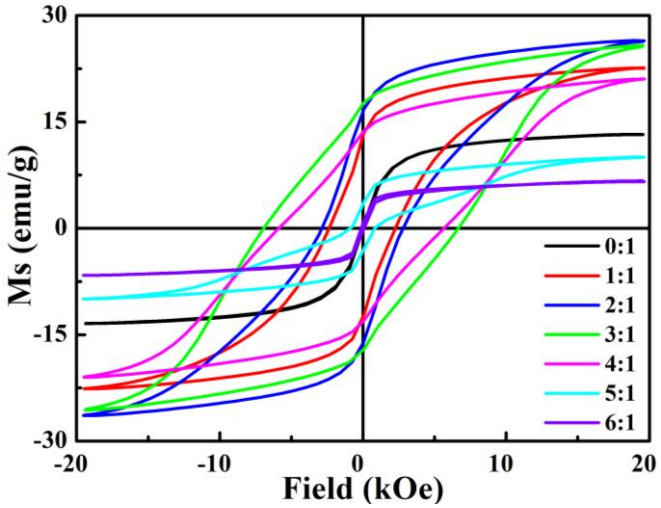

Figure S4. The hysteresis loops of FePt NPs synthesized with a different Cl^-/Pt^{2+} mole ratio at 350 ^oC for 3 h.

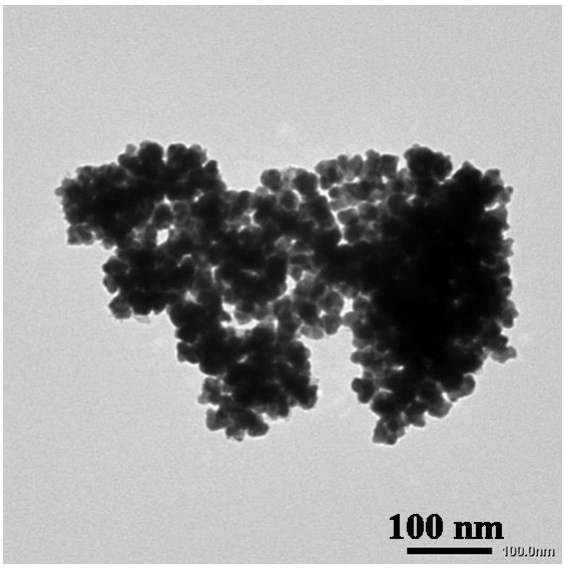

Figure S5. The TEM image of the NPs synthesized with $FeCl_2 \cdot 4H_2O$ and $Pt(acac)_2$ at 350 °C for 3 h.

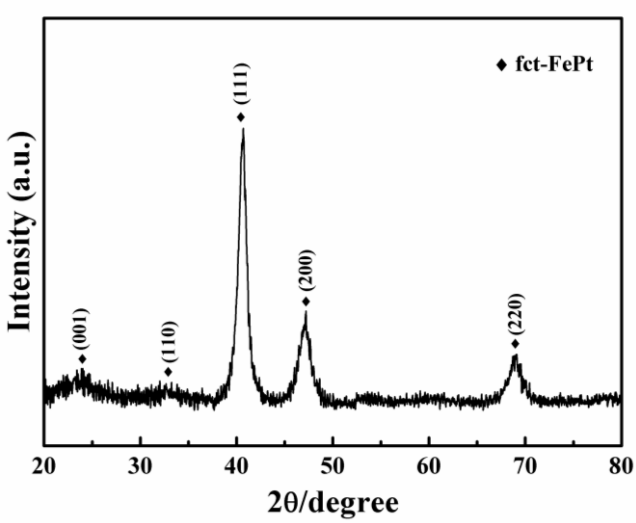

Figure S6. The XRD pattern of the NPs synthesized with $FeCl_2 \cdot 4H_2O$ and $Pt(acac)_2$ at 350 °C for 3 h.

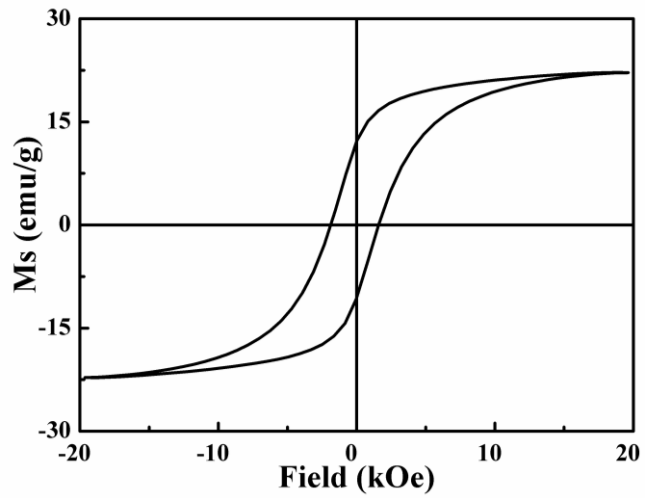

Figure S7. The hysteresis loop of the NPs synthesized with $FeCl_2 \cdot 4H_2O$ and $Pt(acac)_2$ at 350 °C for 3 h.

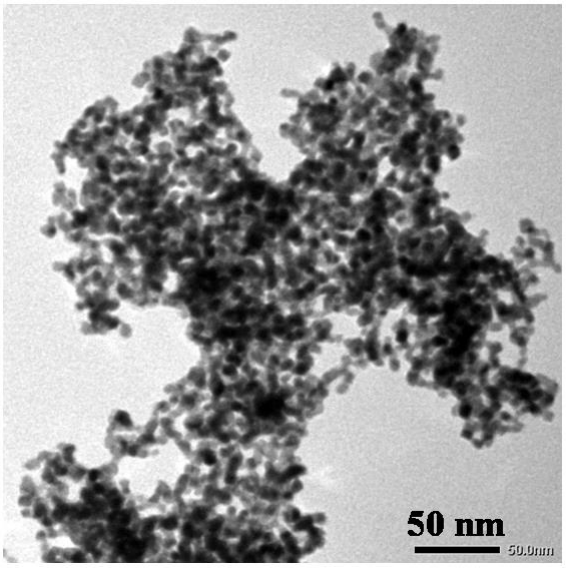

Figure S8. The typical TEM image of the NPs synthesized by replacing NH_4Cl with $(NH_4)_2SO_4$ at 350 °C for 3 h.

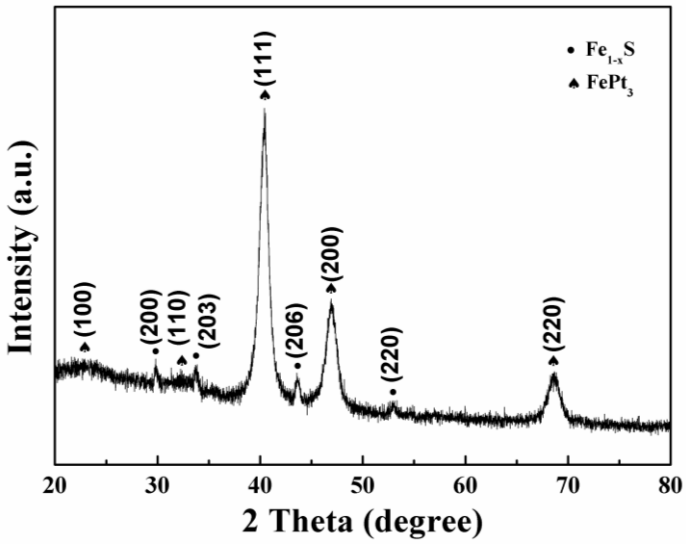

Figure S9. The XRD pattern of the NPs synthesized by replacing NH_4Cl with $(NH_4)_2SO_4$ at 350 ^oC for 3 h.

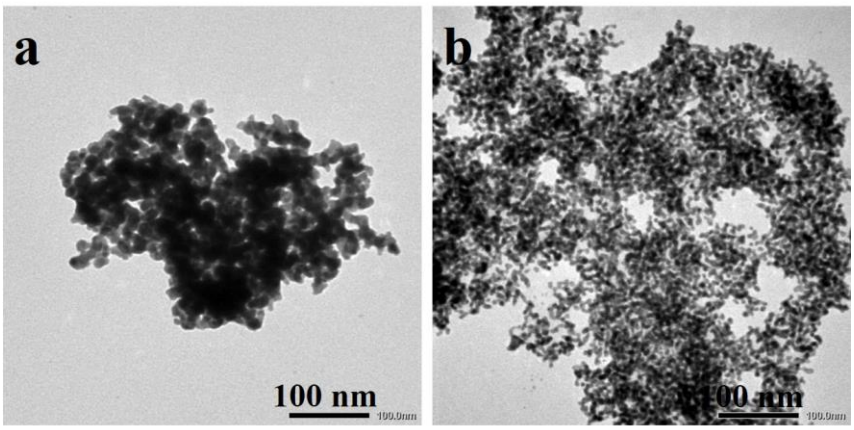

Figure S10. The TEM images of FePt NPs synthesized by addition of (**a**) KI and (**b**) KBr at 350 ^oC for 3 h.

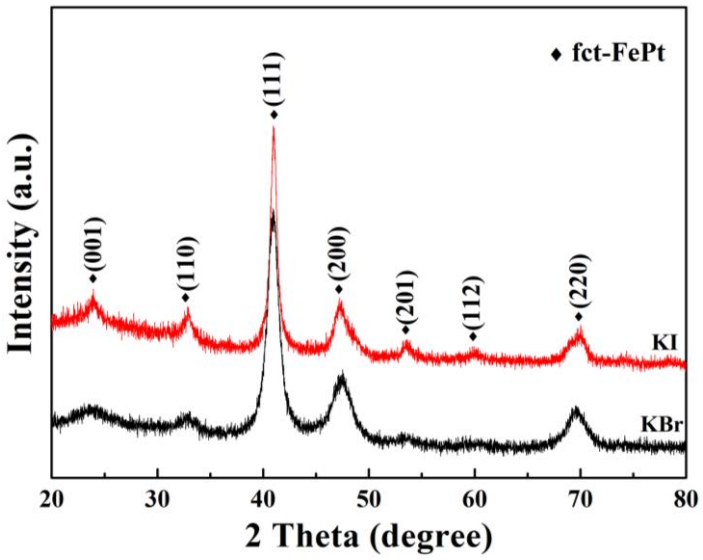

Figure S11. The XRD patterns of FePt NPs synthesized by addition of KI and KBr at 350 ^{o}C for 3 h.

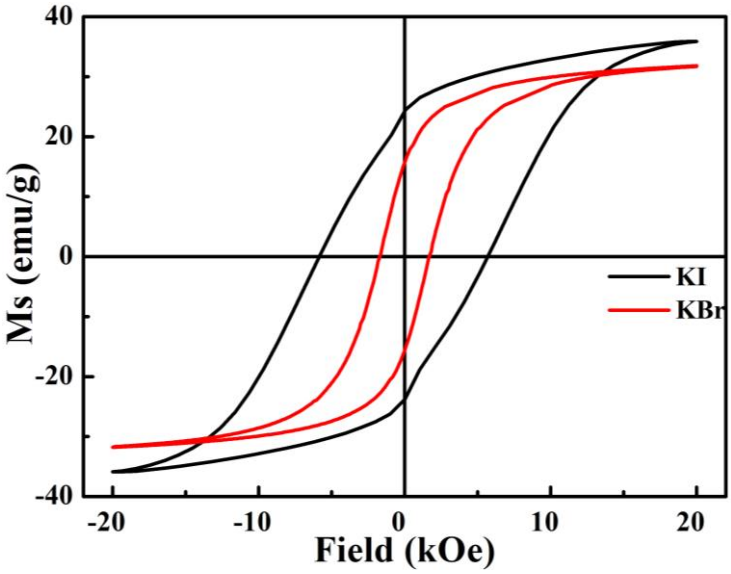

Figure S12. The hysteresis loops of FePt NPs synthesized by addition of KI and KBr at 350 ^{o}C for 3 h.