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Electronic Supplementary Information

Achieving High Performance Electromagnetic Wave Attenuation: A Rational Design of Silica Coated Mesoporous Iron Microcubes

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Calculation of volume change

The pore volume was calculated based on a fact that the size of these cubes was nearly unchanged after reduction (according to electon microscope investigations). After the reduction, the removal of oxygen atoms from α-Fe_2O_3 resulted in pore inside of the cubes. We caculated the volume of oxygen atoms and then estimated the pore volume. The molar volumes of α-Fe_2O_3 and cubic Fe (determined by XRD, Figure 1) are 30.39 and 7.09 cm^3/mol. Given the same molar amount of Fe and same size of the cube, the volume of unoccupied space inisde of a cube shoud be 53.3% (46.7% volume is occupied by Fe) after reducing α-Fe_2O_3 to cubic Fe:

$$V_{Fe}\%=100\% \times (2 \times d_{Fe}) / 30.39 = 46.7\%$$

where $V_{Fe}\%$ is the volume of Fe occupied in a cube and d_{Fe} is the density of cubic Fe.

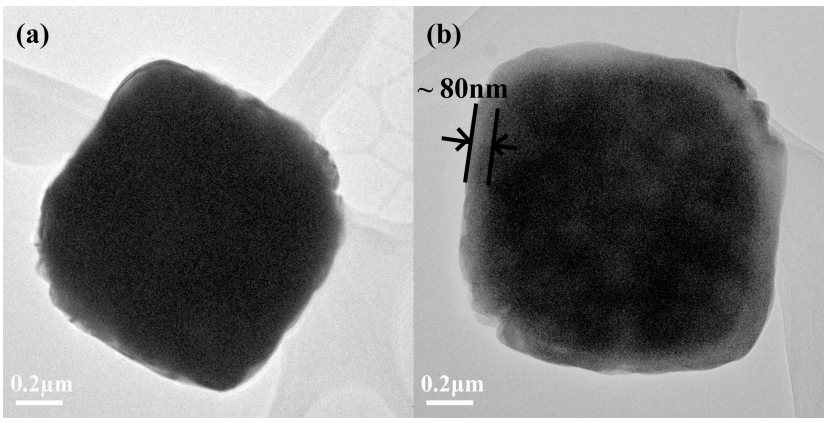

Figure S1. TEM images of as-prepared α-Fe_2O_3 microcubes a) and α-Fe_2O_3 microcubes after SiO_2 coating.

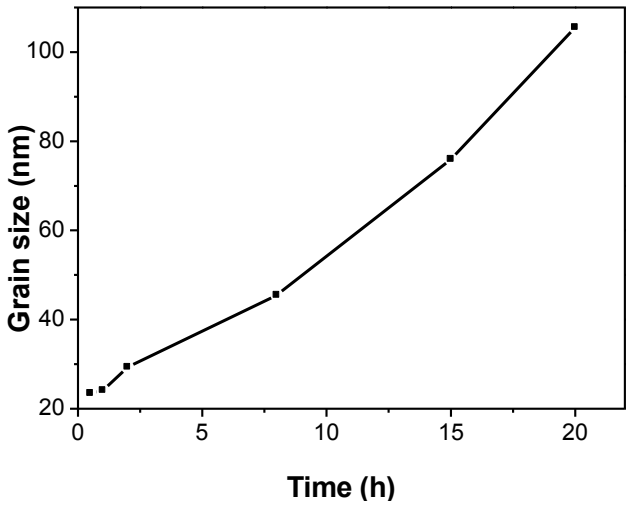

Figure S2. Calcuated grain sizes at different reaction times based on XRD results.

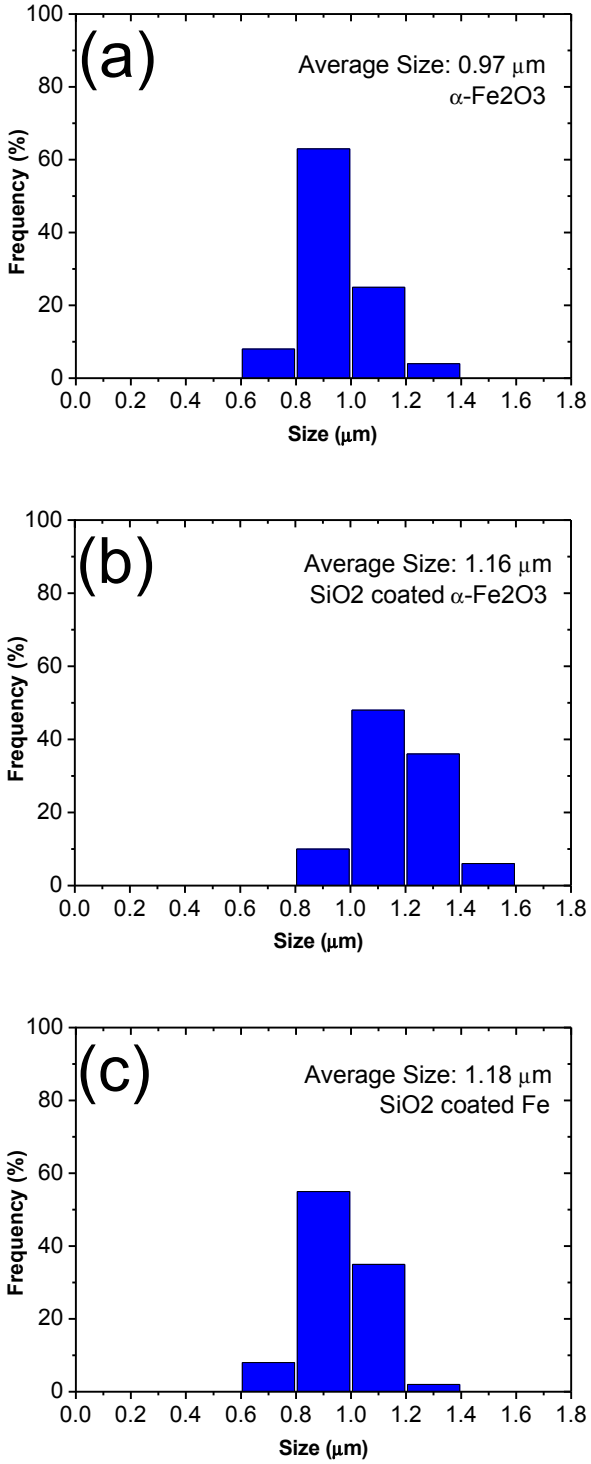

Figure S3. Particle size distribution of the as-prepared α-Fe_2O_3 (a), SiO_2 coated α-Fe_2O_3 (b) and SiO_2 coated Fe.

Element	Atomic%
Si	11.44
Fe	27.71
Pt	3.42
O	57.43
Totals	100

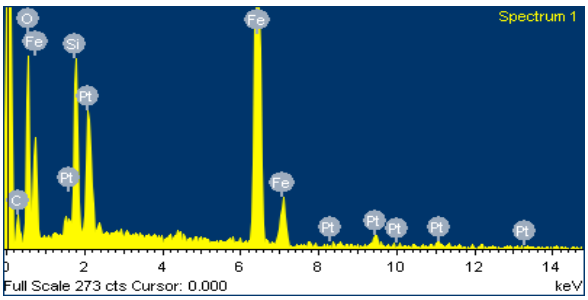

Figure S4. EDS spectrum of as-synthesized Fe@SiO_2 cubes. Pt signal comes from the Pt coating on the sample.

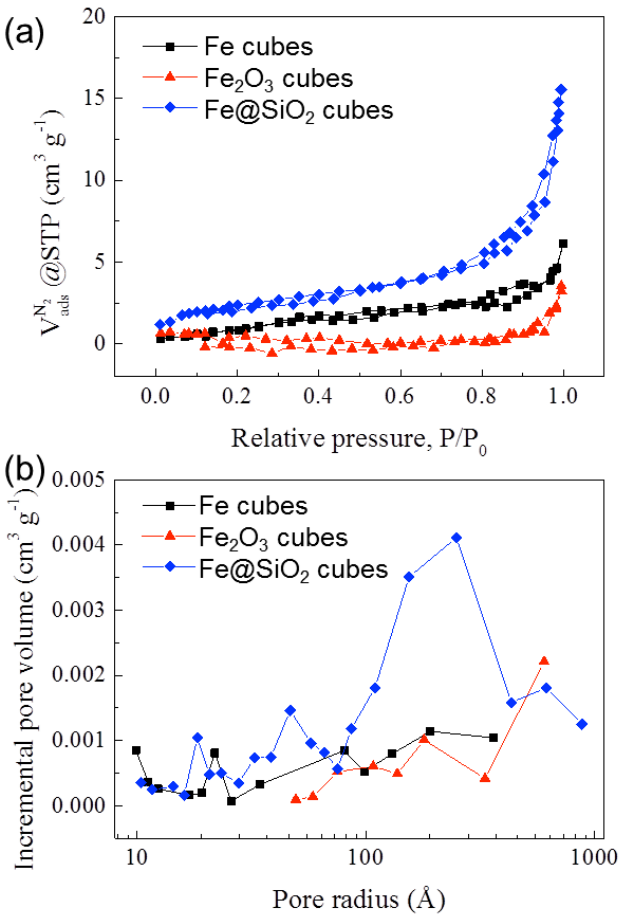

Figure S5. Nitrogen adsorption-desorption isotherms and pore size distribution curves of Fe cubes, Fe_2O_3 cubes, and Fe@SiO_2 cubes. The BET specific surface areas of Fe cubes, Fe_2O_3 cubes, and Fe@SiO_2 cubes are 4.3, 0.3, and 8.6 m^2/g, respectively. Nitrogen adsorption measurements were performed on a Micromeritics TriStar® II 3020 at 77 K. Brunauer−Emmett−Teller (BET) and Barret-Joyner-Halenda (BJH) methods were used for the surface area and pore size distribution (PSD) determination using N_2 adsorption data.

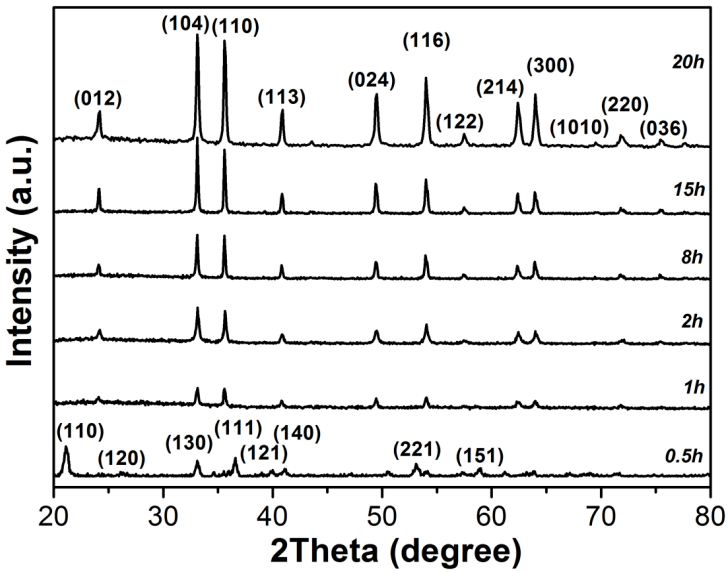

Figure S6. XRD patterns of the iron oxide products obtained through the hydrothermal reaction at different reaction time.

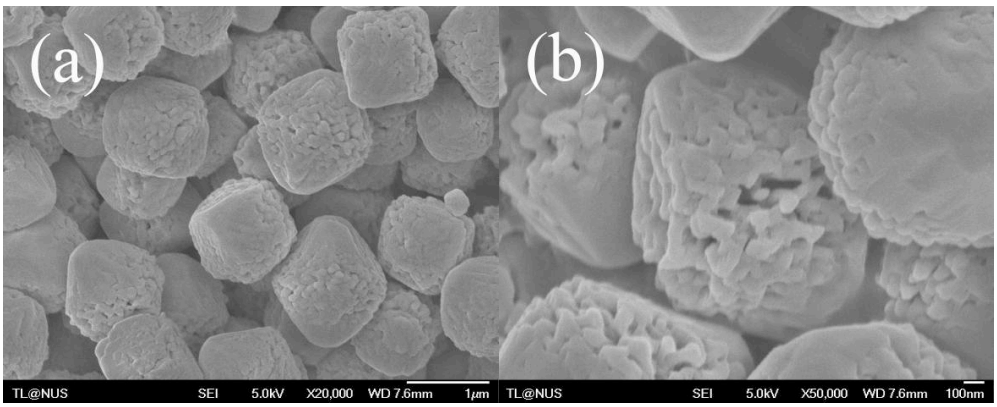

Figure S7. SEM images of the products without using CTAB as capping agent. The surfactant CTAB should play an important role in the formation of the cubic shape. Those samples synthesized without CTAB under the same reaction conditions were like cubic shape, but not in well-defined cube. The particle size of these α-Fe_2O_3 particles is similar to the size of the cubic α-Fe_2O_3 particles synthesized using CTAB.

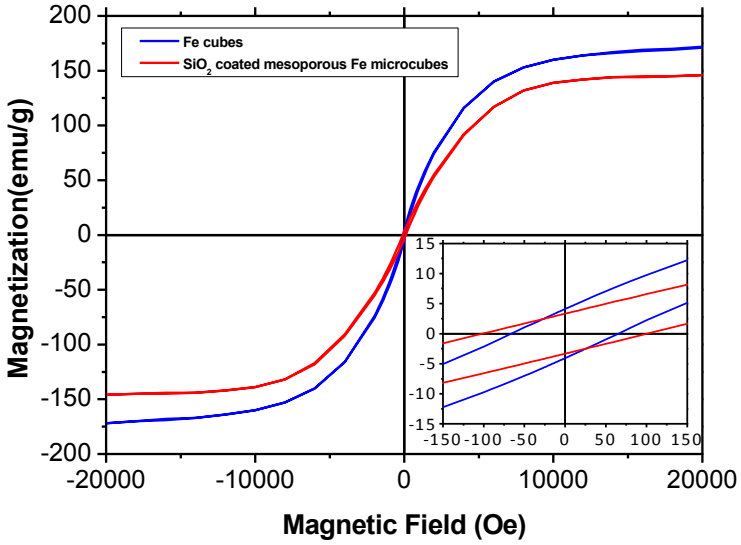

Figure S8. The hysteresis loops of irregular Fe and SiO_2 coated mesoporous Fe microcubes measured at room temperature. The saturation magnetization value (Ms) of the reduced samples without SiO_2 coating (iron particles) is about 171 emu/g and the coercivity (H_c) value is around 59 Oe. The Ms of the reduced samples without SiO_2 coating is smaller than the highest Ms (220 emu/g) reported for the bulk iron. This can be explained by the presence of a few weak magnetic iron oxides on the surface of samples which has been confirmed by the XRD results. For the samples with the coating layer of SiO_2(Fe@SiO_2 cubes), the value of Ms is around 146 emu/g which is also smaller than the highest Ms of bulk iron. This decrease in magnetism is attributed mainly to the decrease in weight ratio of Fe in the particles.