Supporting Information

Synthesis of Magnetite Nanorods from the Reduction of Iron Oxy-Hydroxide with Hydrazine

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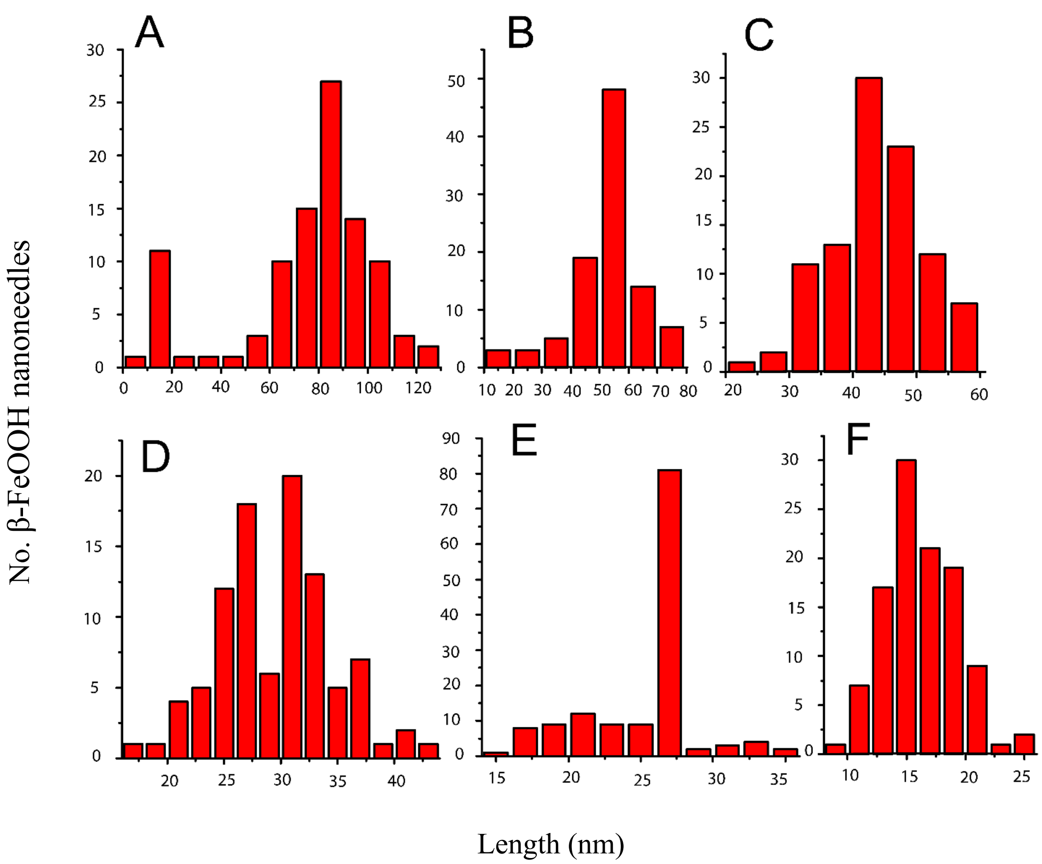

Figure S1. Histogram showing the length distribution of β-FeOOH nanoneedles synthesized using A) 1 mg/mL, B) 1.5 mg/mL, C) 2.0 mg/mL, D) 2.5 mg/mL, E) 5.0 mg/mL, and F) 10.0 mg/mL PEI concentration. The vertical axis (y-axis) represents counts of nanoneedles and horizontal axis (X-axis) represents lengths in the nm scale.

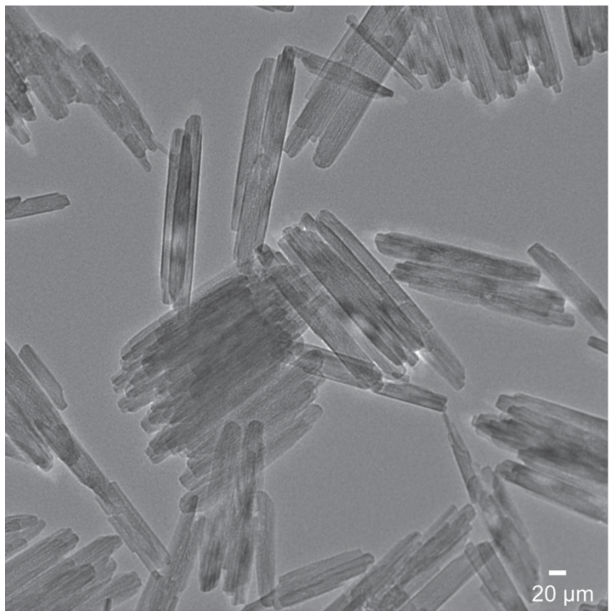

Figure S2. TEM image of β-FeOOH nanoneedles synthesized without using the capping agent (PEI). [$l = 200 \pm 20$ μm, $w = 20 \pm 5$ μm]

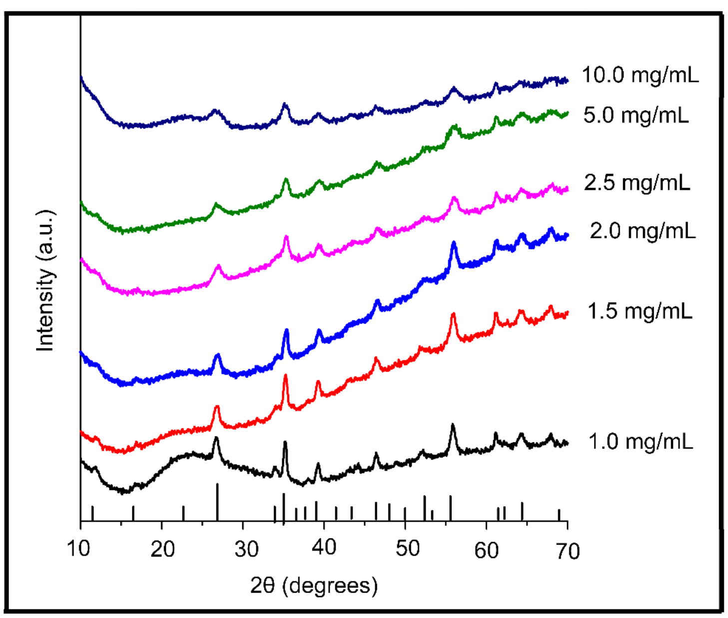

Figure S3. XRD patterns of different aspect ratios of β-FeOOH nanoneedles synthesized as a function of the concentration of capping agent (PEI).

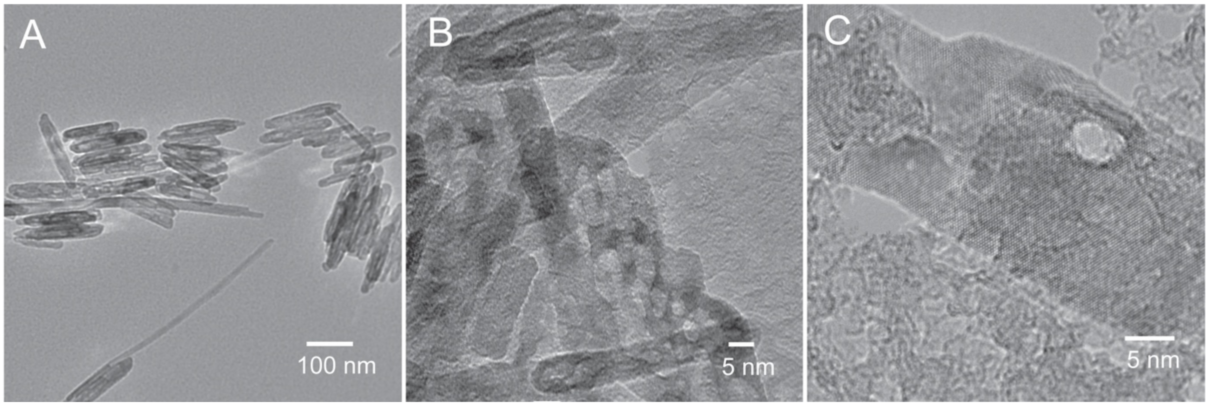

Figure S4. TEM images of magnetite nanorods showing the porous structure: A) magnetite particles were synthesized in 8 h using 10.8 mmol of hydrazine; B) TEM image of magnetite nanorods synthesized in 6 h (10.8 mmol of hydrazine); and C) a higher magnification TEM image of particles shown Figure S4B with a clear void on the surface of the magnetite particle after reduction with hydrazine.

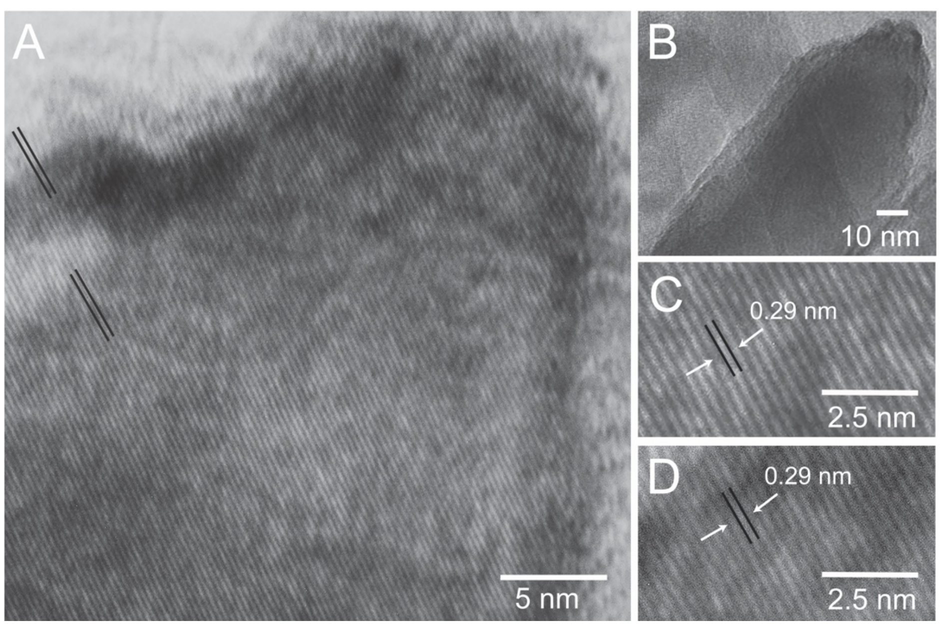

Figure S5. TEM image of phase transformed β-FeOOH with 11.4 mmol of hydrazine showing lattice fringes with d-spacing corresponding to the (220) plane of Fe_3O_4 in the core as well as at the edge of the nanorod. A) TEM image showing the same interatomic distance at the core and edge of the nanorod; B) single nanorod; and enlarged view of C) edge and D) core marked in Figure S5A with a d-spacing of 0.29 nm.

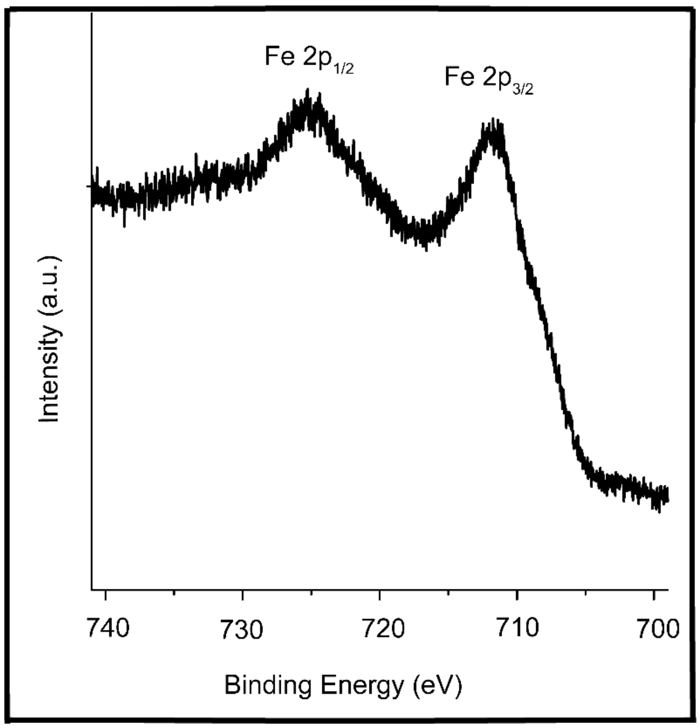

Figure S6. XPS spectrum of Fe_3O_4 nanorods synthesized with 10.8 mmol of hydrazine at an 8 h reaction time. The binding energy (B.E.) of 711.7 and 724.5 eV for Fe $2p_{3/2}$ and Fe $2p_{1/2}$ without the satellite peak around 720 eV confirms the consistent transformation of β-FeOOH into Fe_3O_4.

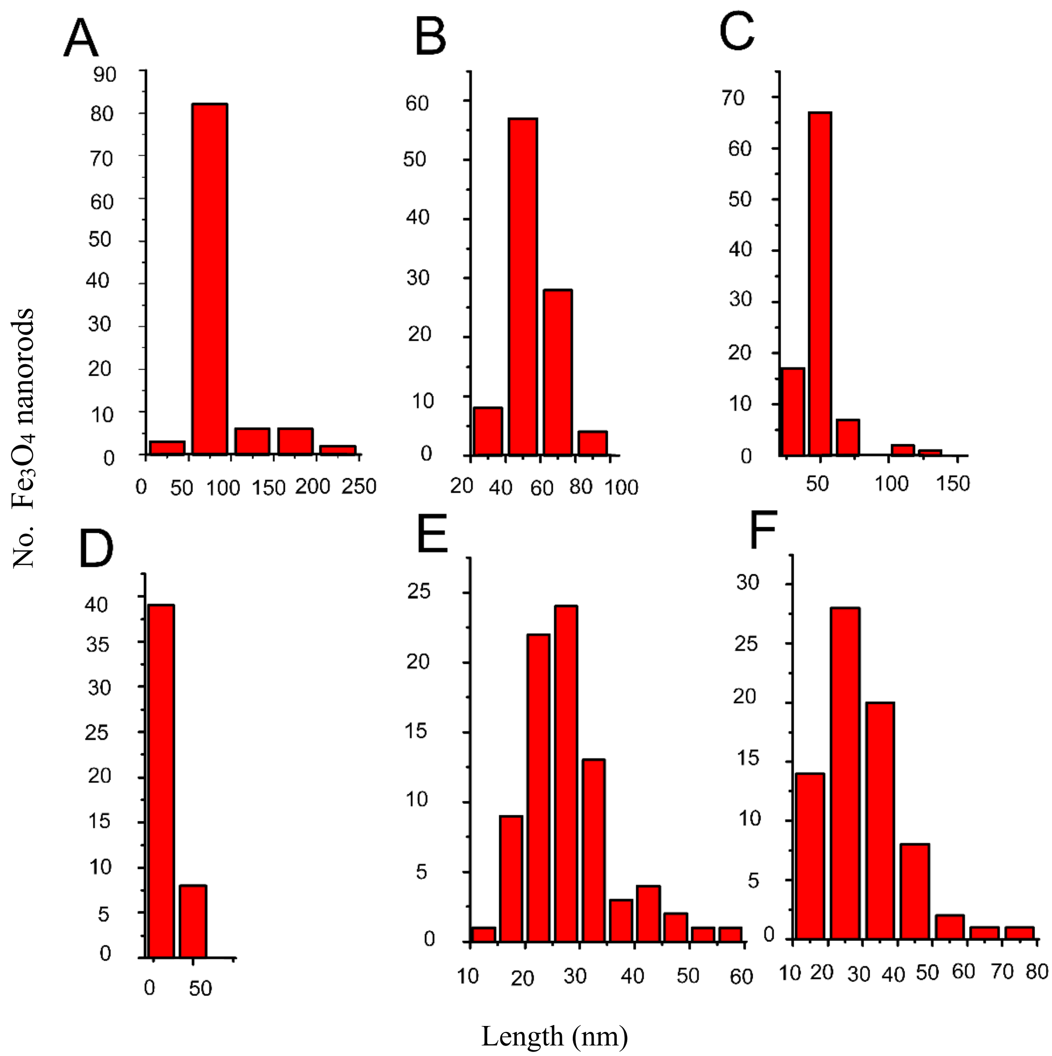

Figure S7. Histogram showing the length distribution of Fe_3O_4 nanorods after reduction of β-FeOOH having aspect ratios of A) 8.0, B) 7.0, C) 6.0), D) 5.7, E) 5.5, and F) 4.0 with 10.8 mmol of hydrazine for 6 h reaction time. The length of nanorods increases on reduction along with the formation of wires and triangular-shaped nanoparticles. The y-axis represents nanorods counts and X-axis represents the length of rods in the nm scale.

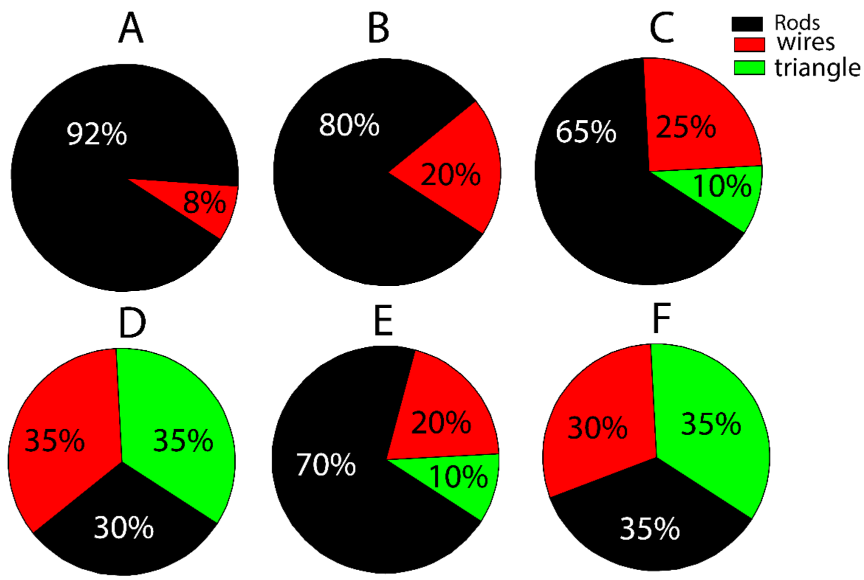

Figure S8. Pie chart showing average shape distribution of Fe_3O_4 particles after the reduction of β-FeOOH nanoneedles with aspect ratios A) 8.0, B) 7.0, C) 6.0, D) 5.7, E) 5.5, and F) 4.0 in presence of 10.8 mmol of hydrazine at reaction time of 6 h. Samples consists of rods, wires, and triangle shapes. The percentage of wires and triangles increases as the aspect ratio of starting material decreases. The data were calculated from TEM images based on the number and tentative surface area covered by different shapes in the images.

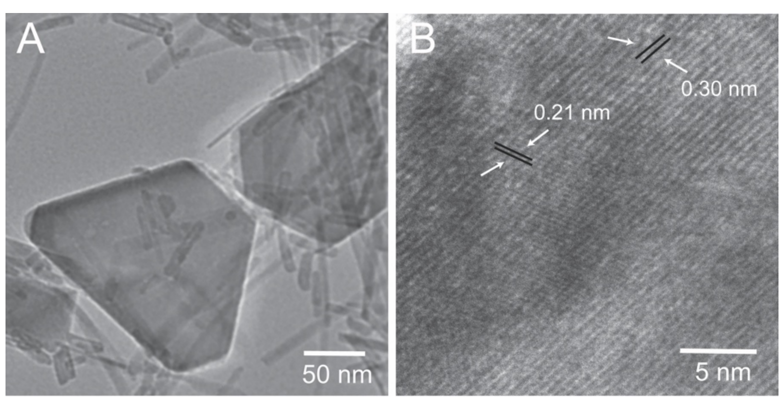

Figure S9. TEM images of A) triangular nanoparticles obtained by treating 5.7 aspect ratio of β-FeOOH nanoneedles with 10.8 mmol of hydrazine, and B) higher magnification TEM image showing d-spacings of 0.30 nm 0.21 nm corresponding to the (220) and (400) planes, respectively, of Fe_3O_4.

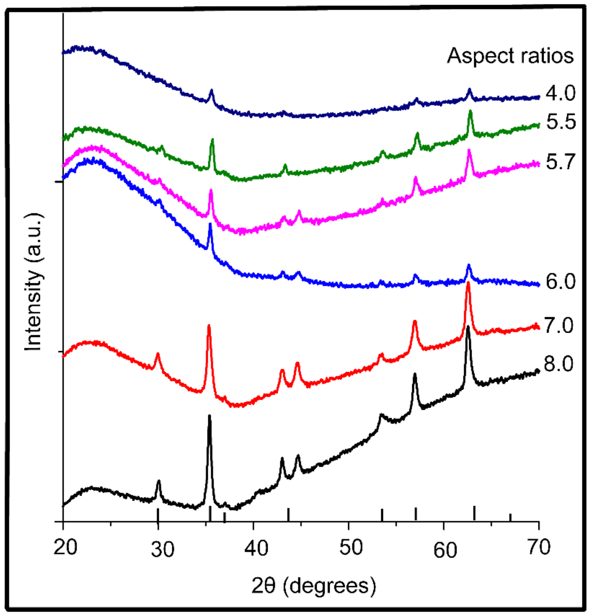

Figure S10. XRD pattern of Fe_3O_4 nanorods obtained after the reduction of different aspect ratios (8.0, 7.0, 6.0, 5.7, 5.5, and 4.0) of β-FeOOH nanoneedles using 10.8 mmol of hydrazine.

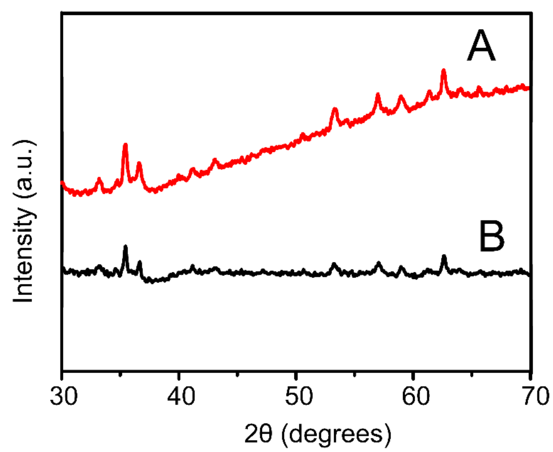

Figure S11. XRD patterns showing that the mixed phases of iron oxide (Fe_3O_4 and γ-Fe_2O_3) are reproducible under the same conditions of increased concentrations of hydrazine: A) attempt 1 and B) attempt 2.