Electronic Supplementary Material (ESI) for CrystEngComm.

Synthesis of various shaped magnetic FeCo nanoparticles and the growth mechanism of FeCo nanocube

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Supporting Information

SI-1

Calculation of reduction potentials of Fe^{2+}/Fe and Co^{2+}/Co for addition of 0.988g NaOH (1.235M) in the original solutions. The standard reduction potentials are ϕ^0 (Fe^{2+}/Fe) = -0.41V, ϕ^0 (Co^{2+}/Co) = -0.29V. The values of K_{sp} are $K_{sp}(Co(OH)_2) = 2.5\times10^{-16}$, $K_{sp}(Fe(OH)_2) = 7.9\times10^{-15}$, and R is the universal gas constant, R=8.314472J k^{-1} mol^{-1}, F is the Faraday constant, F= 9.648534×10^4C mol^{-1}.

The concentration of free OH^-, except the OH^- which form $Fe(OH)_2$ and $Co(OH)_2$,

$$[OH^-] = (1.235 - 0.2)M = 1.035M$$

The concentration of Fe^{2+} and Co^{2+} in the presence of 1.235M NaOH are, respectively,

$$[Fe^{2+}] = \frac{K_{sp}(Fe(OH)_2)}{[OH^-]^2} = 7.37\times10^{-15}$$

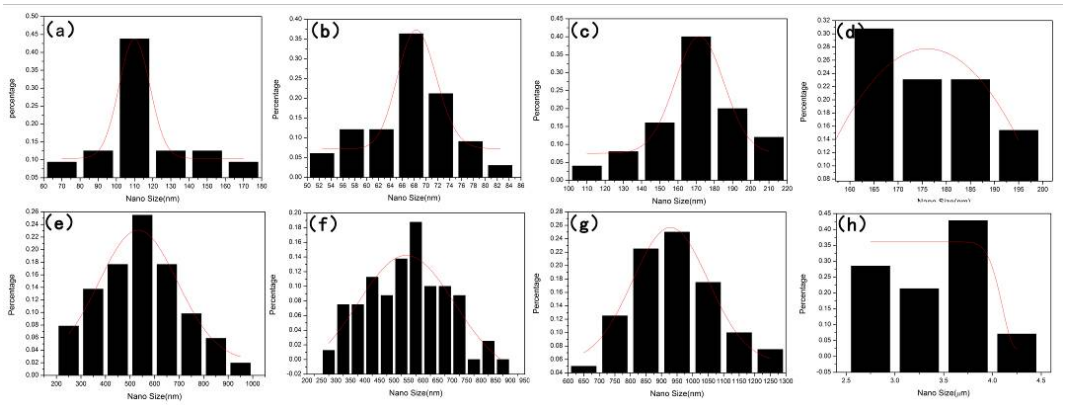
$$[Co^{2+}] = \frac{K_{sp}(Co(OH)_2)}{[OH^-]^2} = 2.33\times10^{-16}$$

So, the reduction potentials by Nernst equation are given as:

$$\Phi(Fe^{2+}/Fe) = \Phi^0\left(Fe^{2+}/Fe\right) + \frac{RT}{2F}\ln[Fe^{2+}] = -0.90V$$

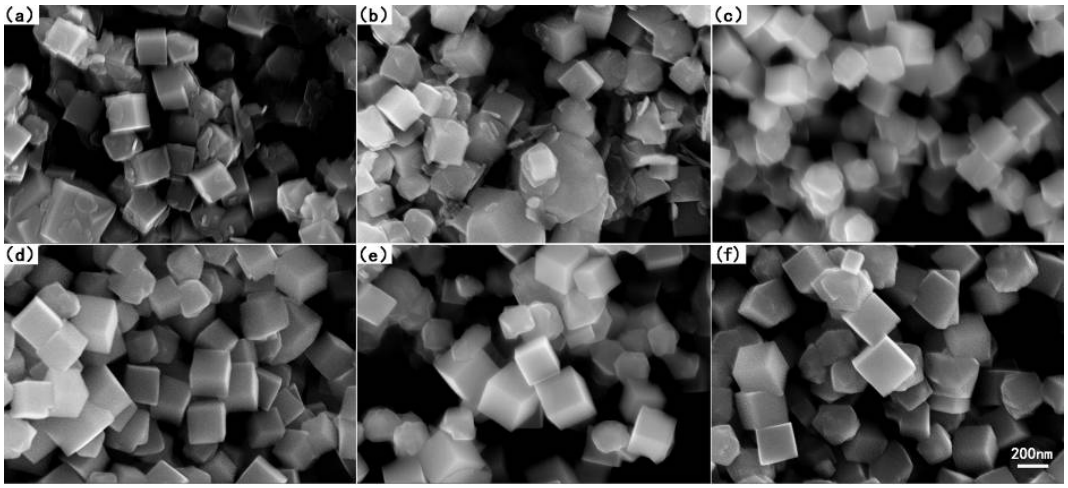
$$\Phi(Co^{2+}/Co) = \Phi^0\left(Co^{2+}/Co\right) + \frac{RT}{2F}\ln[Co^{2+}] = -0.84V$$

SI-2



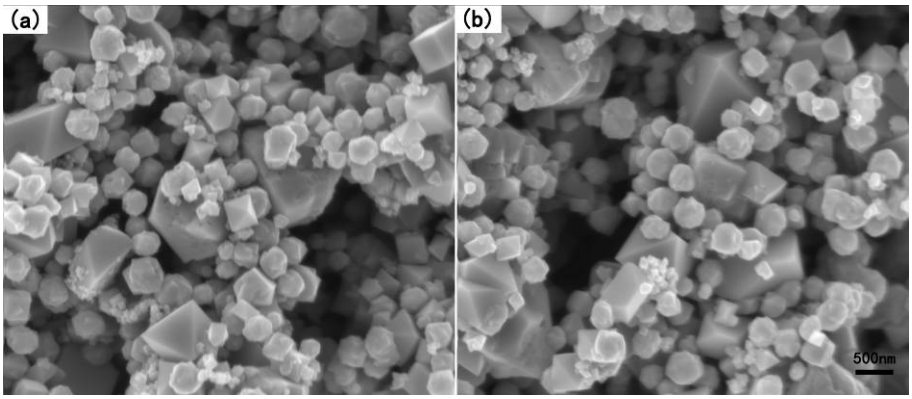
SI-2 (a)-(h) are the corresponding microscopy-derived size distribution of which the molar ratios of Fe^{2+} and Co^{2+} are 5:1, 4:1, 3:1, 2:1, 1:2, 1:3, 1:4 and 1:5, respectively. Size distributions are based on 80-100 nanoparticles observed in the same sample. The sizes correspond to the mean cubic side length.

SI-3



SI-3 While the molar ratio of Fe^{2+} to Co^{2+} is 3:1, the nanocubes which are synthesized at (a) 80°C, (b) 100°C, (c)120°C, (d)140°C, (e)160°C, (f)180°C, in the presence of 2.752g PEG-400 and 0.32mL cyclohexane for 3h.

SI-4



SI-4 SEM micrographs of FeCo nanoparticles obtained with $[Fe^{2+}] + [Co^{2+}]$ =0.1M,

$[Fe^{2+}] / [Co^{2+}]$ =3:1, (a) PVP-K30, 2g, (b) PVP-K30, 5g.