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Supporting Information

Flower-like Co superstructures: Morphology and phase evolution mechanism and novel microwave electromagnetic characteristics

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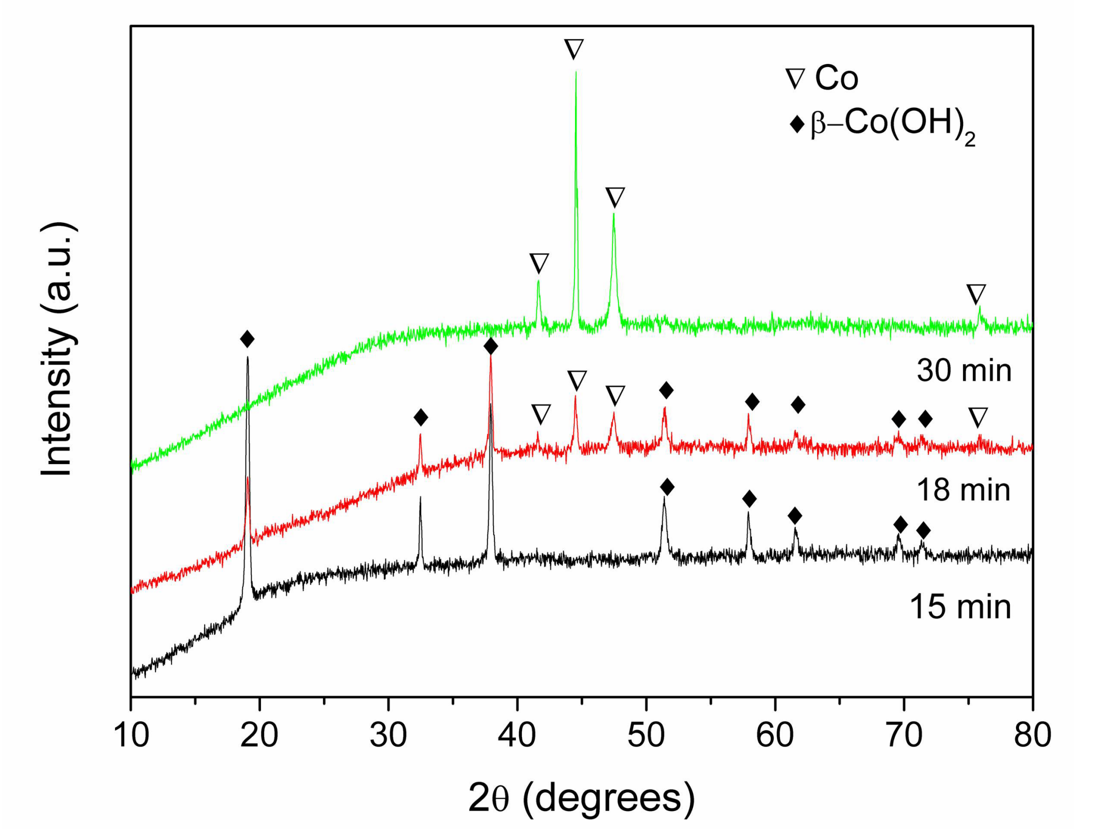

Illustration S1. XRD patterns of the evolution process at 15, 18, and 30 min, respectively.

The time evolution of the reaction was recorded in order to trace the growth of the flower-like Co superstructures. Seen from XRD patterns in Illustration S1, only β-$Co(OH)_2$ are produced before 15 min of reaction, and small quantities of hexagonal close-packed (HCP) Co begin to form after 18 min of reaction. At a reaction time of 30 min, β-$Co(OH)_2$ completely transforms into HCP Co metal.

Illustration S2. Calculation of the electrode potentials in different conditions using $N_2H_4.H_2O$ as reducing agent.

No	α	$[Co^{2+}]$ **M·L^{-1}**	[NaOH] **M·L^{-1}**	$[OH^-]$ **M·L^{-1}**	$\varphi(Co^{2+}/Co)$ **V**
1	0	0.225	0	1.18×10^{-5}	-0.307
2	2.22	0.225	0.5	0.050	-0.764
3	4.44	0.225	1	0.550	-0.845
4	8.89	0.225	2	1.550	-0.880
5	4.44	0.0225	0.10	0.055	-0.767
6	4.44	0.05	0.22	0.120	-0.794
7	4.44	0.10	0.44	0.240	-0.817
8	65.6	0.0305	2.00	1.939	-0.888

$\varphi^{\Theta}(Co^{2+}/Co)$= - 0.282V $\varphi^{\Theta}(N_2/N_2H_4)$= - 1.15 V

$K_s(Co(OH)_2)$=1.09 ×10^{-15}

$[\mathrm{Co}^{2+}]=K_s(Co(OH)_2)/[OH^-]^2$

According to Nernst equation

$$\varphi(Co^{2+}/Co)=\varphi^{\Theta}(Co^{2+}/Co)+(RT/2F)\ln[Co^{2+}]$$

$$\varphi(N_2/N_2H_4)=\varphi^{\Theta}(N_2/N_2H_4)+(\mathrm{RT/4F})\ln[\mathrm{H}^+]^4[\mathrm{N_2H_4}]^{-1}$$

$$\varphi(N_2/N_2H_4)=\varphi^{\Theta}(N_2/N_2H_4)+(\mathrm{RT/4F})\ln[\mathrm{OH}^-]^{-4}[\mathrm{N_2H_4}]^{-1}$$

Calculation of $\varphi(Co^{2+}/Co)$ using $NaH_2PO_2\cdot H_2O$ as reducing agent.

No	$[Co^{2+}]$ M·L^{-1}	[NaOH] M·L^{-1}	$[OH^-]$ M·L^{-1}	$\varphi(Co^{2+}/Co)$ V	$\varphi(HPO_3^{2-}/H_2PO_2^-)$ V	E V
1	0.0305	2.0	1.939	-0.888	-1.684	0.796

$\varphi^{\ominus}(Co^{2+}/Co)$=-0.282V $\varphi^{\ominus}(HPO_3^-/H_2PO_2^-)$=-1.65V

$K_s(Co(OH)_2)$=1.09 $\times 10^{-15}$

$[Co^{2+}]=K_s(Co(OH)_2)/[OH^-]^2$

According to Nernst equation

$$\varphi(Co^{2+}/Co)=\varphi^{\ominus}(Co^{2+}/Co)+(RT/2F)\ln[Co^{2+}]$$

$$\varphi(HPO_3^-/H_2PO_2^-)=\varphi^{\ominus}(HPO_3^-/H_2PO_2^-)+(RT/2F)\ln[HPO_3^-]/([H_2PO_2^-]\cdot[OH^-]^3)$$

Calculation of $\varphi(Co^{2+}/Co)$ using $NaBH_4$ as reducing agent.

No	$[Co^{2+}]$ M·L^{-1}	[NaOH] M·L^{-1}	$[OH^-]$ M·L^{-1}	$\varphi(Co^{2+}/Co)$ V	$\varphi(H_2O/BH_4^-)$ V	E V
1	0.0305	2.0	1.939	-0.888	-1.262	0.374

$\varphi^{\ominus}(Co^{2+}/Co)$=-0.282V $\varphi^{\ominus}(H_2O/BH_4^-)$=-1.24V

$K_s(Co(OH)_2)$=1.09 $\times 10^{-15}$

$[Co^{2+}]=K_s(Co(OH)_2)/[OH^-]^2$

According to Nernst equation

$$\varphi(Co^{2+}/Co)=\varphi^{\ominus}(Co^{2+}/Co)+(RT/2F)\ln[Co^{2+}]$$

$$\varphi(H_2O/BH_4^-)=\varphi^{\ominus}(H_2O/BH_4^-)+(RT/8F)\ln[BO_2^-]/([BH_4^-]\cdot[OH^-]^8)$$

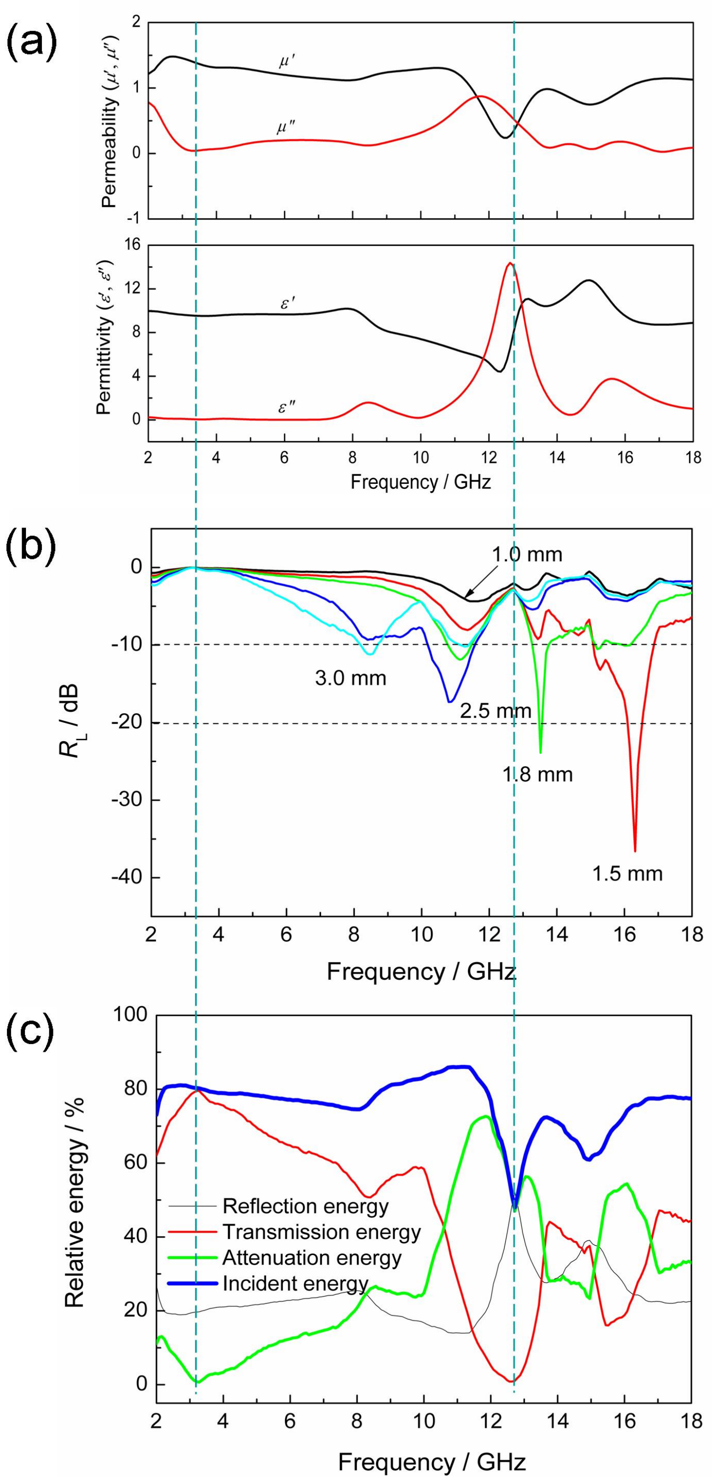

Illustration S3. Frequency dependence of (a) the complex permittivity(ε', ε'') and permeability (μ', μ''), (b) the reflection loss (R_L), and (c) the relative energy of the spherical Co powders/wax composites in a mass ratio of 1:1.

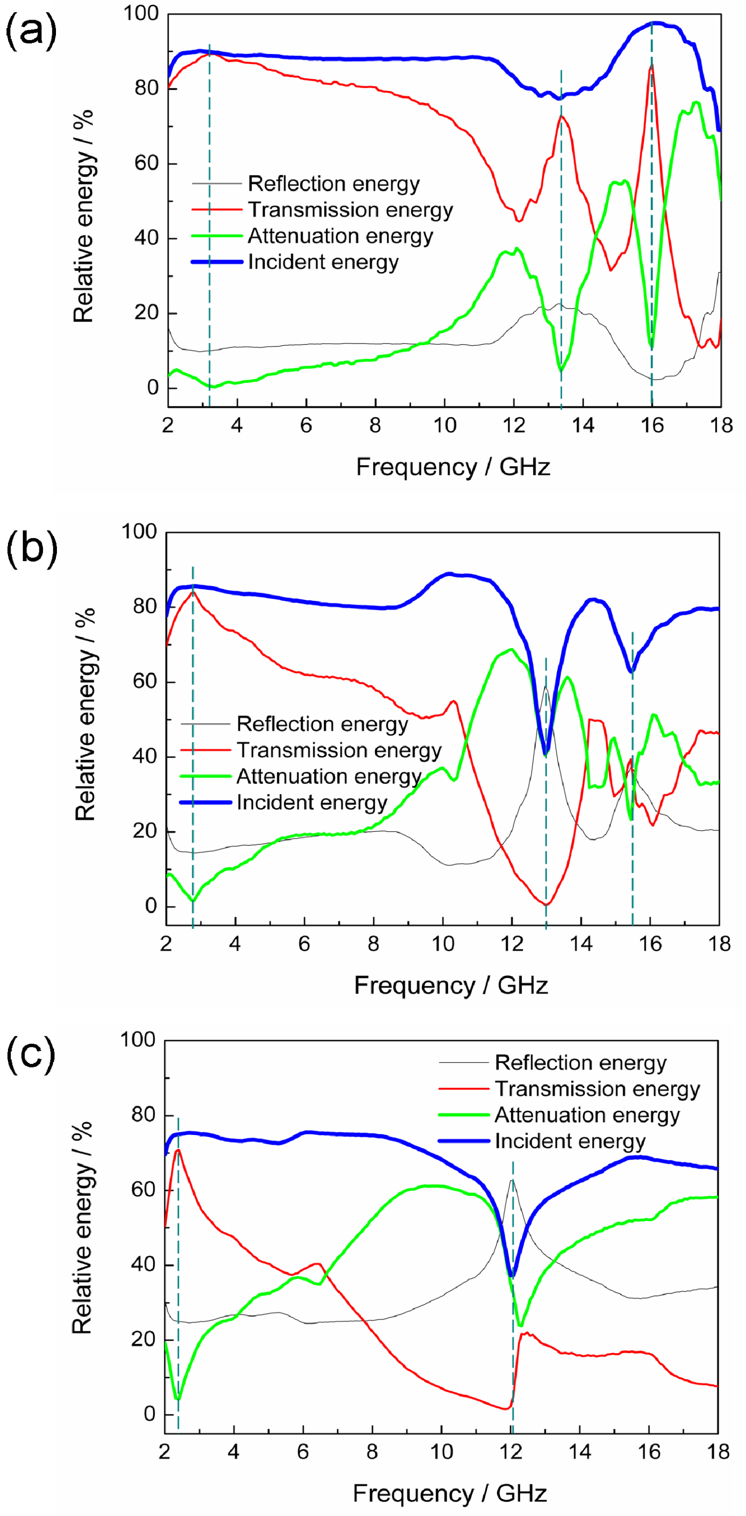

Illustration S4. Frequency dependence of the relative energy of the wax-composites with various mass ratios of flower-like Co powders to wax of: (a) 1:2, (b) 1:1, and (c) 2:1.