Supplementary Information

Template-free Polymorph Discrimination and Synthesis of Calcium Carbonate Mineral

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Characterization of the sampels. X-ray power diffraction (XRD) analyses were carried out on a Philips X'Pert PRO SUPER X-ray diffractometer equipped with graphite monochromatized Cu Kα radiation. Field emission scanning electron microscopy (FESEM) was carried out with a field emission scanning electron microanalyzer (JEOL-6700F). Transmission electron microscope (TEM) and high resolution TEM (HRTEM) were performed on JEOL-2010 operated at an acceleration voltage of 200 kV. Fourier transform infrared (FT-IR) spectra were measured on a MAGNA-IR 750 (Nicolet Instrument Co. USA).

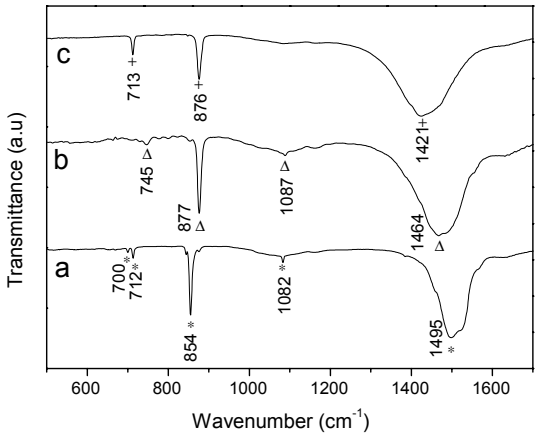

Figure S1. FT-IR spectra of $CaCO_3$ samples obtained by double-jet method at a rate of 1 $ml \cdot h^{-1}$. (a) 50 °C; (b) 25 °C; (c) 0 °C aging 8 hours, after aging 8 hours . [$CaCl_2$] = 100 mM, volume = 1.5 mL; [Na_2CO_3] = 100 mM, volume = 1.5 mL; 10 mL double-distilled water in the reaction vessel. Note: ∗, aragonite phase; Δ, vaterite phase; +, calcite phase.

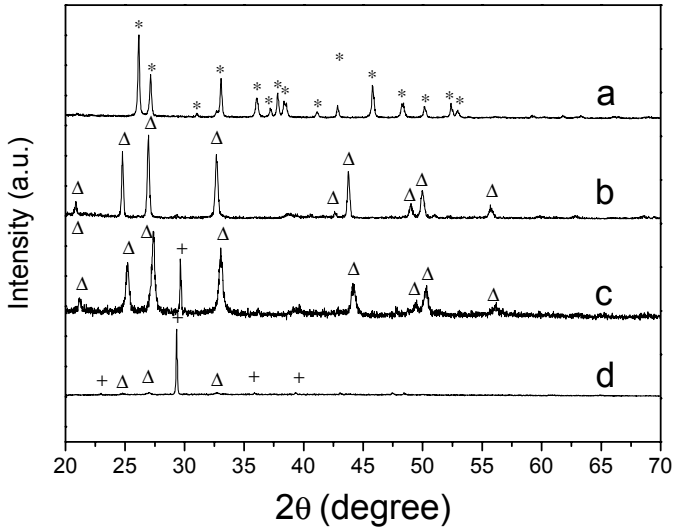

Figure S2. XRD patterns of $CaCO_3$ samples obtained by double-jet method at a rate of 0.2 $mL \cdot min^{-1}$. (a) 50 °C, pure aragonite. (b) 38 °C, pure vaterite. (c) 25 °C, a mixture of vaterite and calcite (vaterite is dominant). (d) 0 °C, a mixture of vaterite and calcite (calcite is dominant). $[CaCl_2] = [Na_2CO_3] = 100$ mM. The volume of each initial solution injected is 1.5 mL, adding into 10 mL double-distilled water in the reaction vessel.

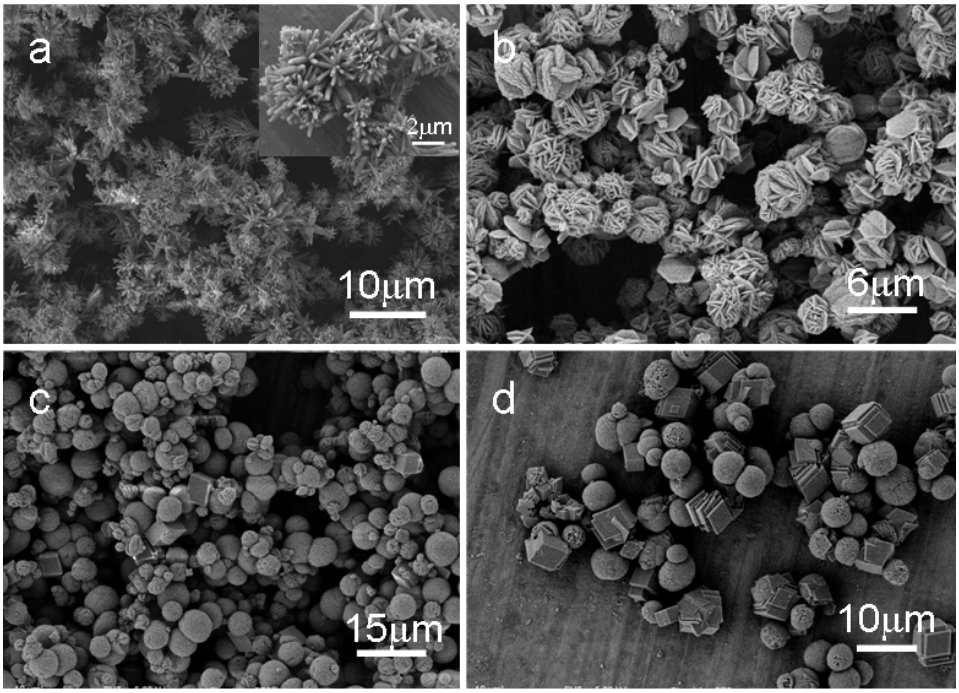

Figure S3. Typical SEM images of the $CaCO_3$ obtained by double-jet method at a rate of 0.2 $mL \cdot min^{-1}$. (a) 50 °C, pure aragonite. (b) 38 °C, pure vaterite. (c) 25 °C, a mixture of vaterite and calcite (vaterite is dominant). (d) 0 °C, a mixture of vaterite and calcite (calcite is dominant). $[CaCl_2] = [Na_2CO_3] = 100$ mM. The volume of each initial solution injected is 1.5 mL, adding into 10 mL double-distilled water in the reaction vessel.

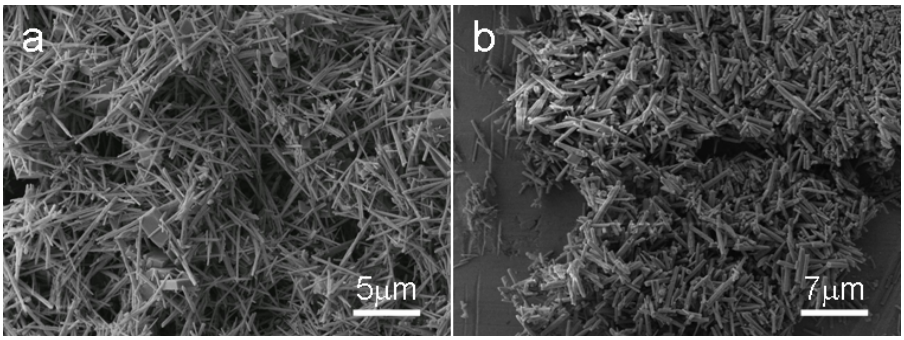

Figure S4. SEM images of the $CaCO_3$ obtained by single-jet method at a rate of 1 ml/h at 50 °C: (a) Na_2CO_3 ([Na_2CO_3] = 100 mM, volume = 1.5 mL) as the single-jet solution, $CaCl_2$ ([$CaCl_2$] = 100 mM, volume = 1.5 mL) is mixed with 10 mL double-distilled water in the reaction vessel; (b) $CaCl_2$ ([$CaCl_2$] = 100 mM, volume = 1.5 mL) as the single-jet solution, Na_2CO_3 ([Na_2CO_3] = 100 mM, volume = 1.5 mL) is mixed with 10 mL double-distilled water in the reaction vessel.

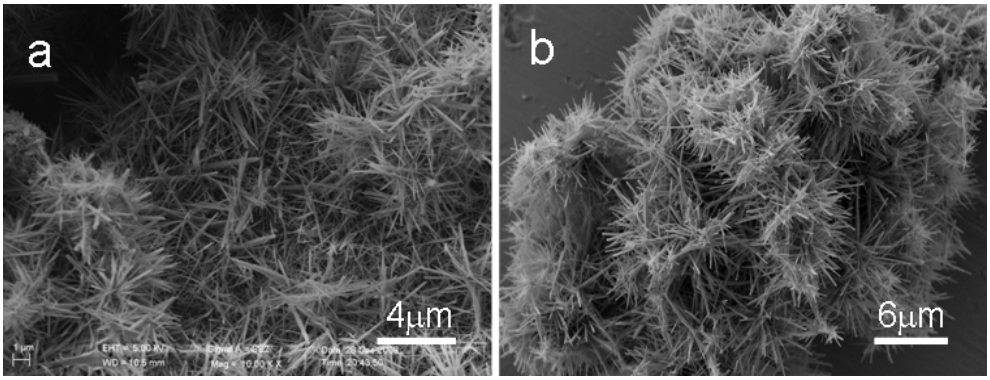

Figure S5. SEM images of the $CaCO_3$ obtained by the double-jet method at a rate of 1 ml/h at 50°C: (a) the sample prepared using 5 mL double-distilled water in the reaction vessel; (b) the sample prepared using 20 ml double-distilled water in the reaction vessel. [$CaCl_2$] = 100 mM, volume = 1.5 mL; [Na_2CO_3] = 100 mM, volume = 1.5 mL.

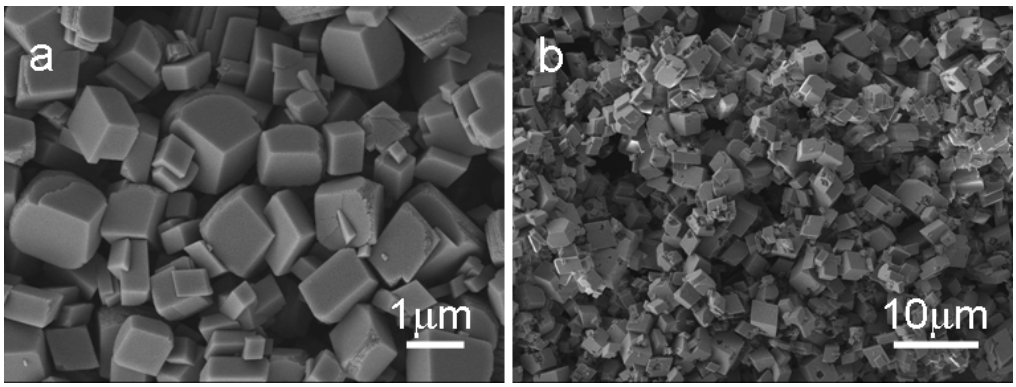

Figure S6. SEM images: (a) calcite seeds; (b) pure calcite obtained, 10mL distilled water and calcite seeds (ESI, Fig. S6a†) were put into the reaction vessel (50°C, 1 mL·h^{-1}, [$CaCl_2$] = 100 mM, volume = 1.5 mL; [Na_2CO_3] = 100 mM, volume = 1.5 mL).