Supporting Information

Control of Crystal Size Distribution in Continuous Cooling Crystallization Using Non-isothermal Taylor Vortex

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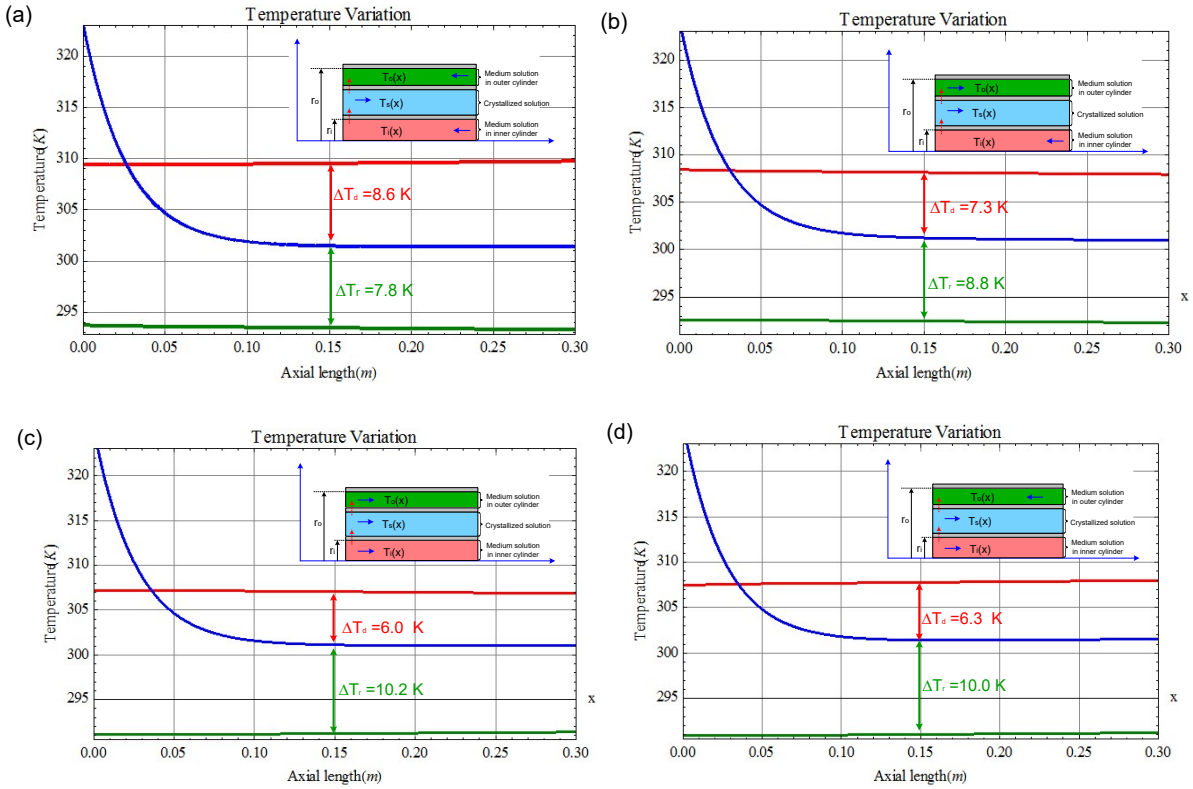

Fig. S1 Simulated temperature profiles of bulks solution and heating-cooling surface with different directions of medium flow: (a) Direction-I (Counter-Counter), (b) Direction-II (Co-Count), (c) Direction-III (Co-Co), (d) Direction-IV (Count-Co).

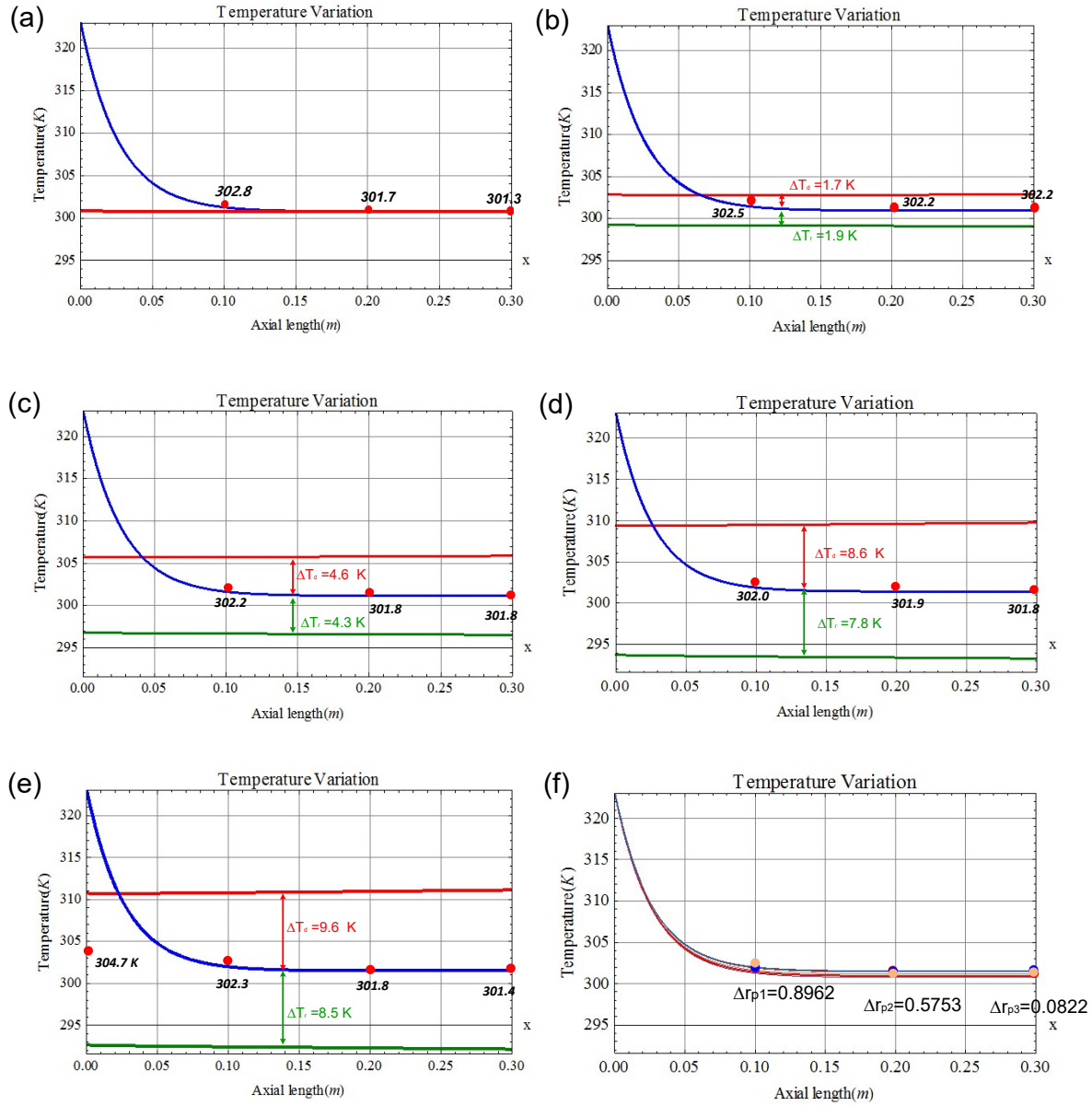

Fig. S2 Simulated temperature profiles of bulk solution and heating-cooling surface with varying temperature differences (ΔT) between inner and outer cylinders: (a) 0 °C, (b) 3.6 °C, (c) 8.9 °C, (d) 16.4 °C, (e) 18.1 °C. (f) Deviation of simulated bulk solution temperature along the axial direction of the crystallizer with varying ΔT.

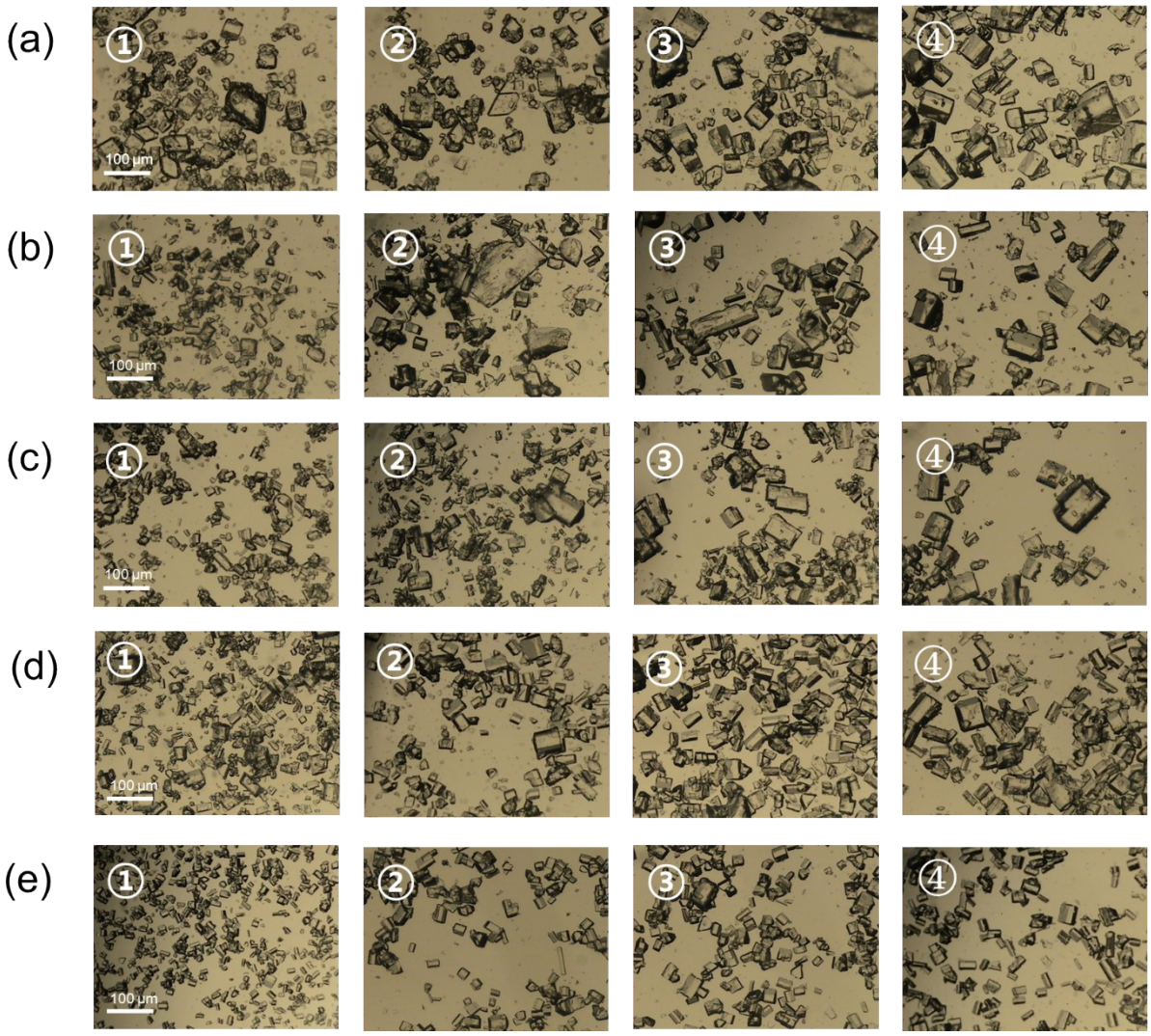

Fig. S3 Optical microscope images of crystals at different axial ports of the non-isothermal CT crystallizer with varying ΔT: (a) 0 °C, (b) 3.6 °C, (c) 8.9 °C, (d) 16.4 °C, (e) 18.1 °C (① Port-I, ② Port-II, ③ Port-III, ④ Port-IV). Crystallization conditions in non-isothermal Mode-I are constant at T_b = 28°C, mean residence time of 5 min, inner cylinder rotation speed of 500 rpm, feeding concentration of 900 g/L, and medium flow direction of Direction-I.

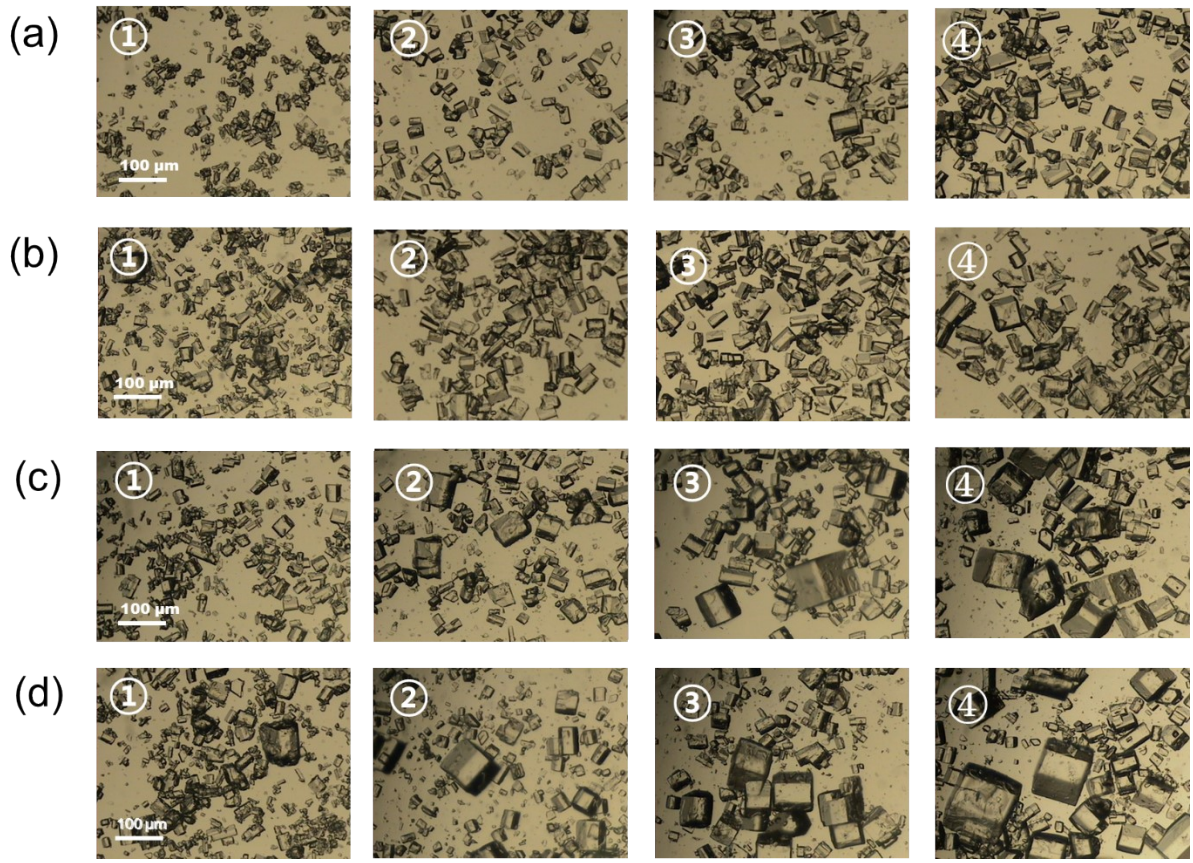

Fig. S4 Optical microscope images of crystals obtained with varying rotation speeds in the non-isothermal CT crystallizer: (a) 200 rpm, (b) 500 rpm, (c) 700 rpm, (d) 900 rpm (① Port-I, ② Port-II, ③ Port-III, ④ Port-IV). Conditions in non-isothermal Mode-I: T_b = 28 °C, ΔT = 16.4 ± 0.2 ºC, mean residence time of 5 min, feeding concentration of 900 g/L, and medium flow direction of Direction-I.

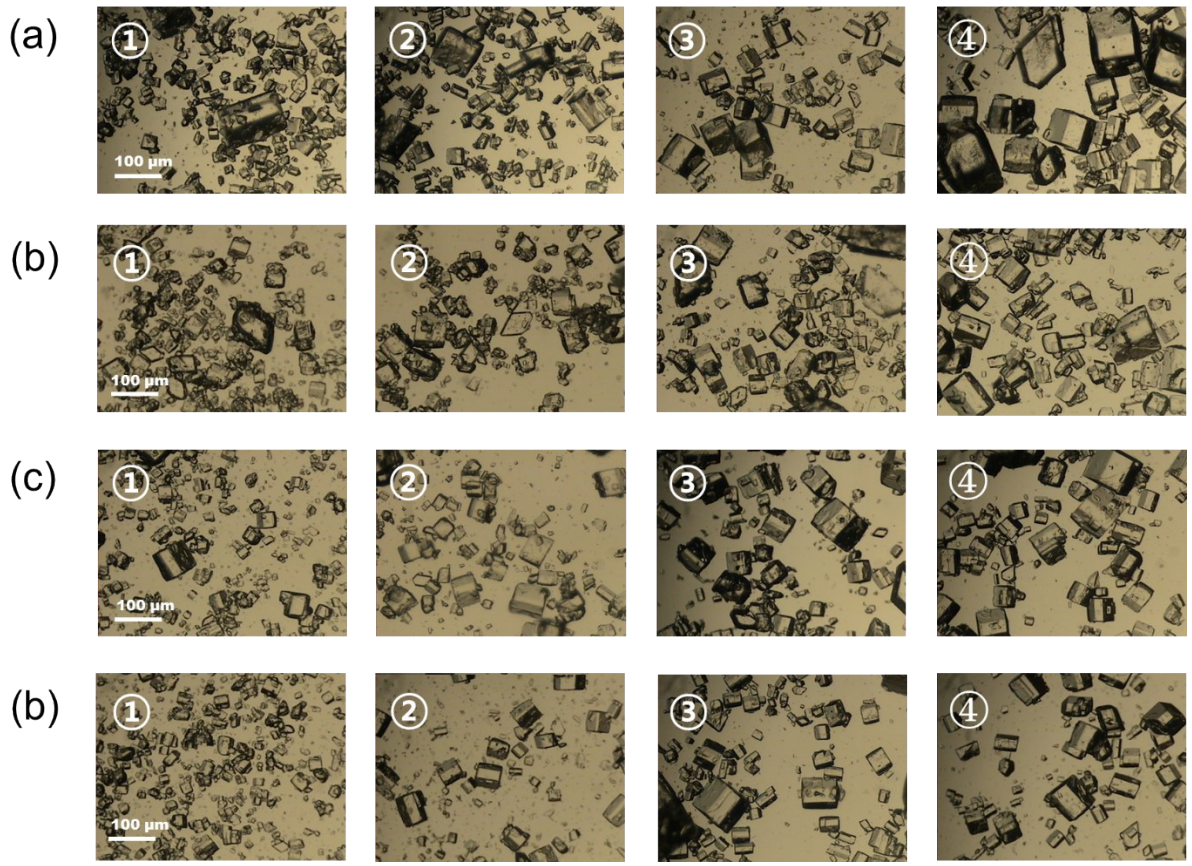

Fig. S5 Optical microscope images of crystals obtained with rotation speeds in the isothermal CT crystallizer: (a) 200 rpm, (b) 500 rpm, (c) 700 rpm, (d) 900 rpm (① Port-I, ② Port-II, ③ Port-III, ④ Port-IV). Conditions: T_b = 28 °C, mean residence time of 5 min, feeding concentration of 900 g/L, and medium flow direction of Direction-I.

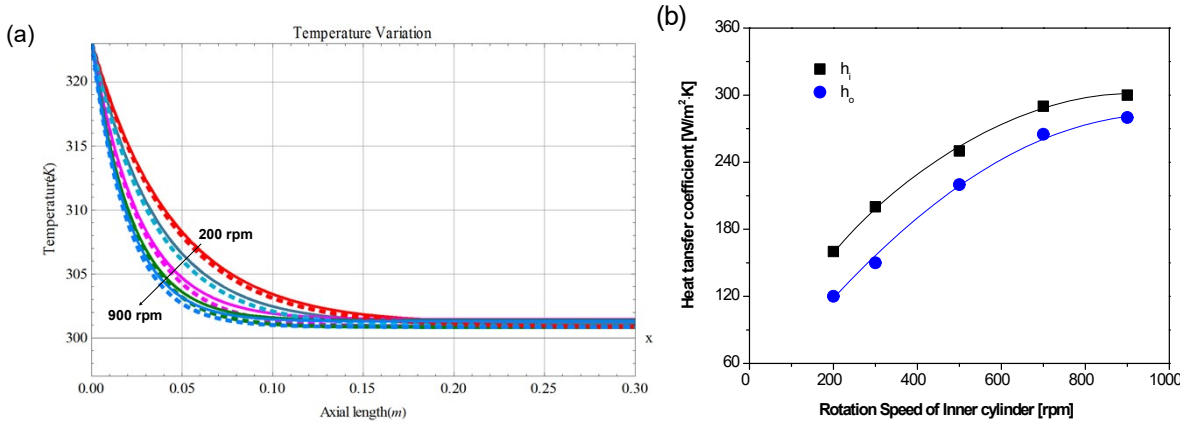

Fig. S6 (a) Simulated temperature profiles of bulk solution in non-isothermal (solid line) and isothermal (dashed line) CT crystallizer. (b) Heat transfer coefficients at inner and outer cylinder surfaces with varying rotation speeds.

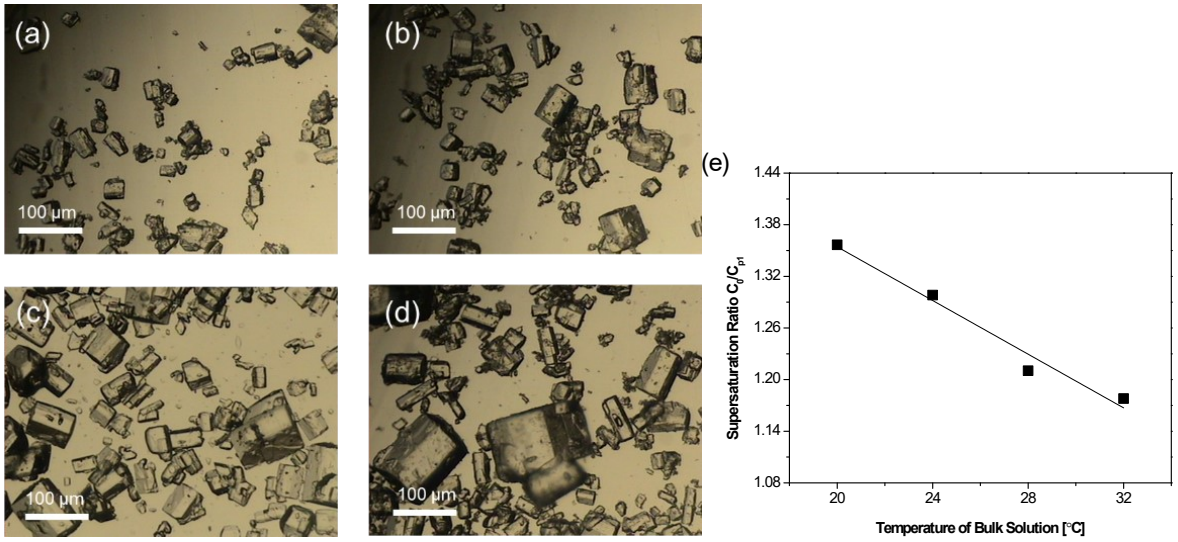

Fig. S7 Optical microscope images of crystals obtained with different bulk solution temperatures in the isothermal CT crystallizer: (a) T_b = 20ºC, (b) 24ºC, (c) 28ºC, (d) 32 ºC. (e) Supersaturation ratio for initial nucleation at Port-I with increasing bulk solution temperature. Conditions: T_b = 28°C, mean residence time of 5 min, rotation speed of inner cylinder of 500 rpm, feeding concentration of 900 g/L, and medium flow direction of Direction-I.

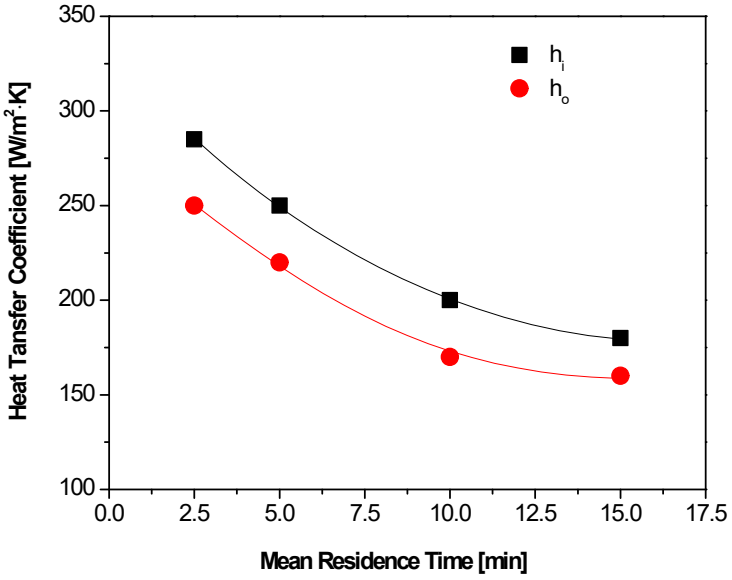

Fig. S8 Heat transfer coefficients at the inner and outer cylinder surfaces with varying mean residence times in the CT crystallizer.

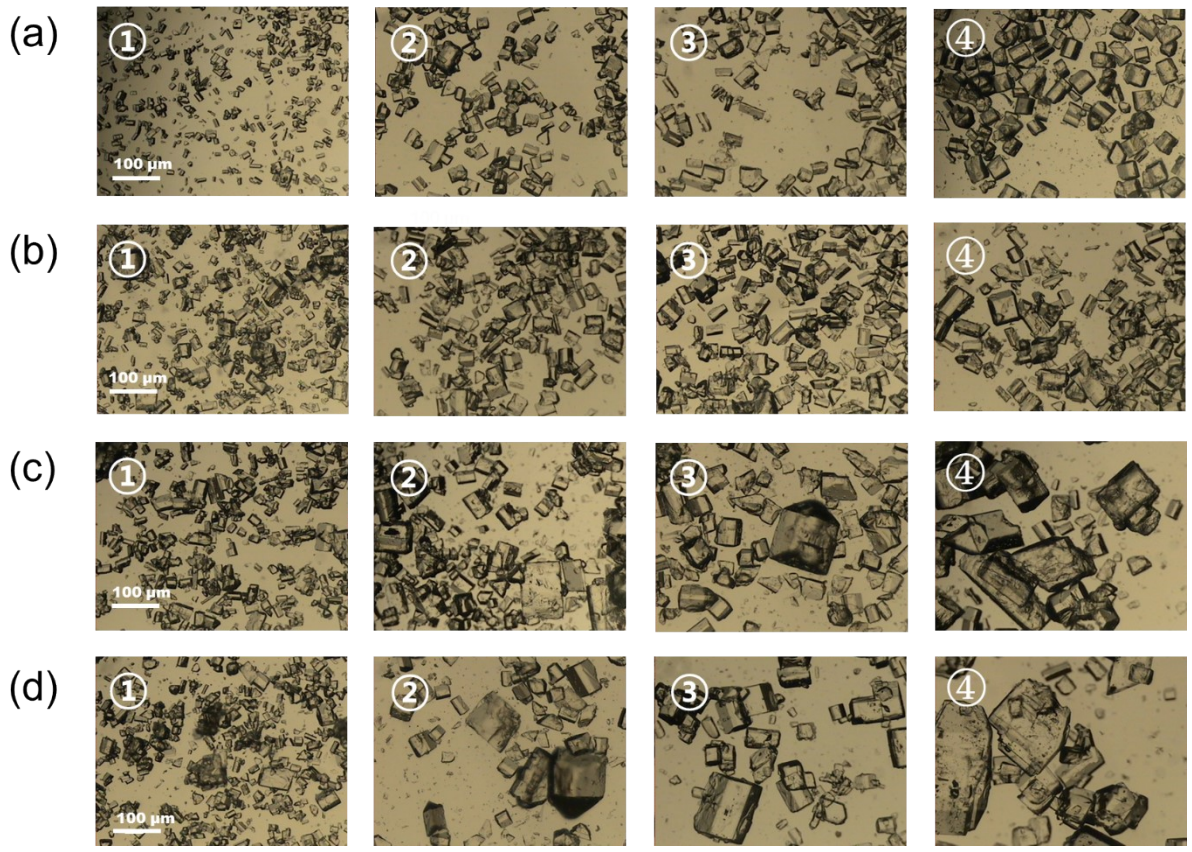

Fig. S9 Optical microscope images of crystals obtained at different mean residence times along axial ports in non-isothermal CT crystallizer: (a) 2.5 min, (b) 5 min, (c) 10 min, (d) 15 min, (① Port-I, ② Port-II, ③ Port-III, ④ Port-IV). Conditions: T_b = 28°C, ΔT =16.4±0.2ºC, rotation speed of inner cylinder of 500 rpm, feeding concentration of 900 g/L, and medium flow direction of Direction-I. And all the yields at different mean residence times are the same.

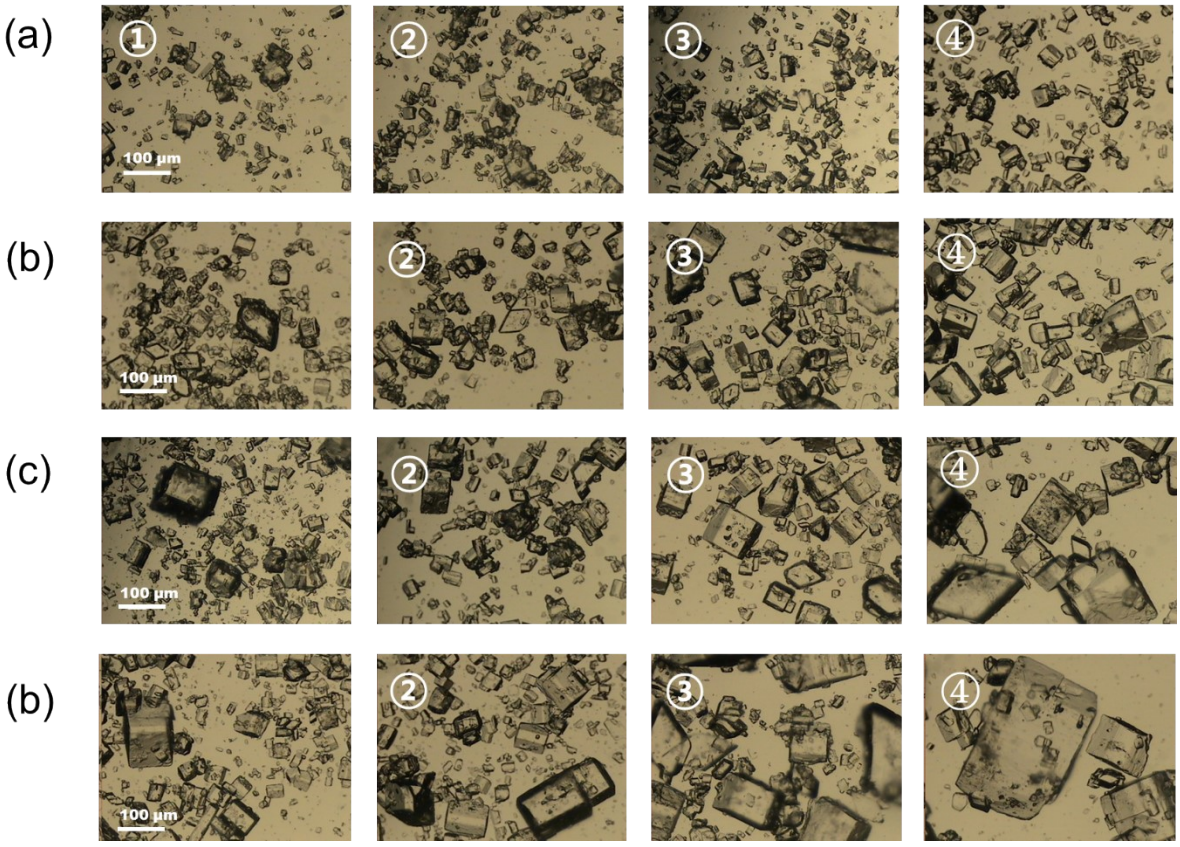

Fig. S10 Optical microscope images of crystals obtained at different mean residence times along axial ports in isothermal CT crystallizer: (a) 2.5 min, (b) 5 min, (c) 10 min, (d) 15 min, (① Port-I, ② Port-II, ③ Port-III, ④ Port-IV). Conditions: T_b = 28 °C, rotation speed of inner cylinder of 500 rpm, feeding concentration of 900 g/L, and medium flow direction of Direction-I.