# Supplementary Materials

# Facile hydrothermal synthesis of $BaTiO_3$ nanoparticles studied by *in situ* X-ray diffraction

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## Selected temperature profiles

Temperature profiles during heating of the capillary were measured with a thermocouple placed inside the sapphire capillary, while the capillary was filled with water and pressurized to 100 bar. Temperature profiles were measured in 50 °C intervals from room temperature (RT) to 400 °C (referring to the set-point temperature of the heat blower). The measured values were then used to calibrate the set-point temperature of the heat blower with the actual temperature inside the capillary.

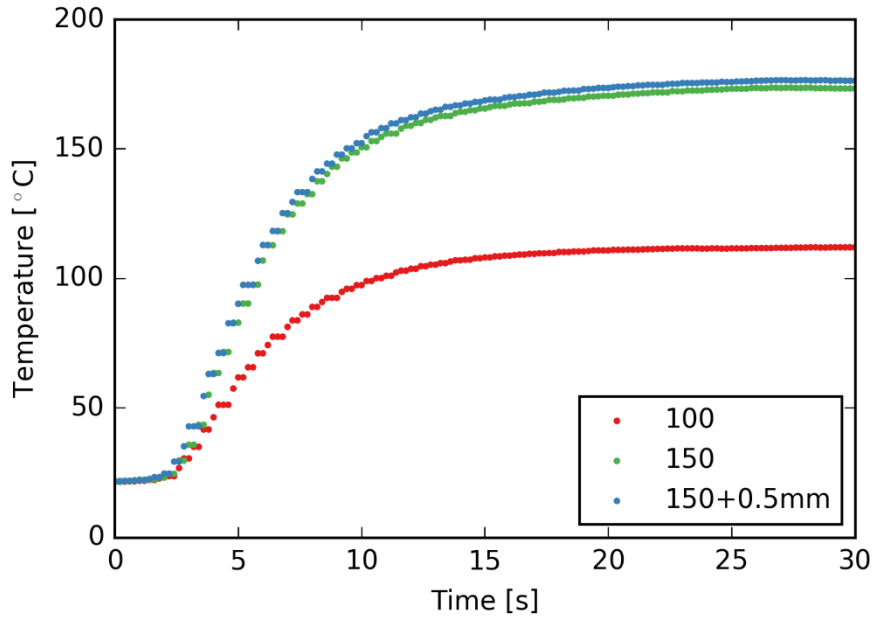


**Figure S1:** Heating profiles for two different set-point temperatures (red (100 °C) and green (150 °C)). Blue data corresponds to 150 °C, but with the capillary moved 0.5 mm closer to the heat blower compared to the green data showing the robustness of this setup.

## Typical Rietveld refinements

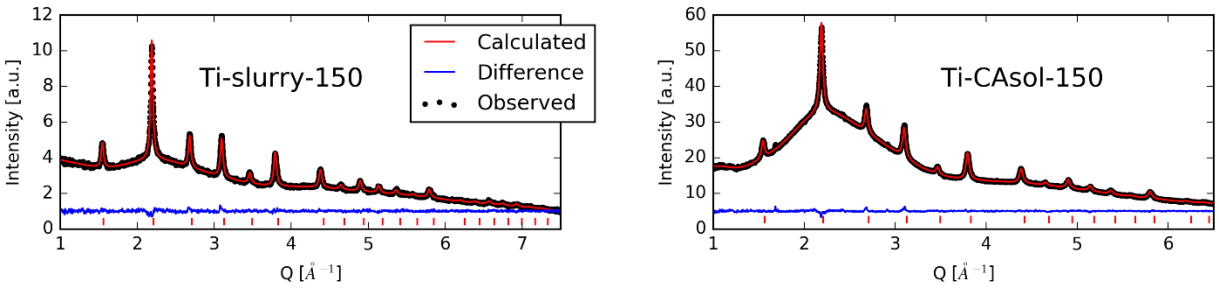


**Figure S2:** Last frames of experiments Ti-CAsol-150 and Ti-slurry-150 showing typical refinements, with red markers showing diffraction lines of $BaTiO_3$ at RT from ICDD card #01-074-4539. Refined

values (R-values, lattice parameter, size, strain and atomic displacement parameters) are reported in Table S1.

**Time resolved atomic displacement parameters for Ti and Ba for all experiments**

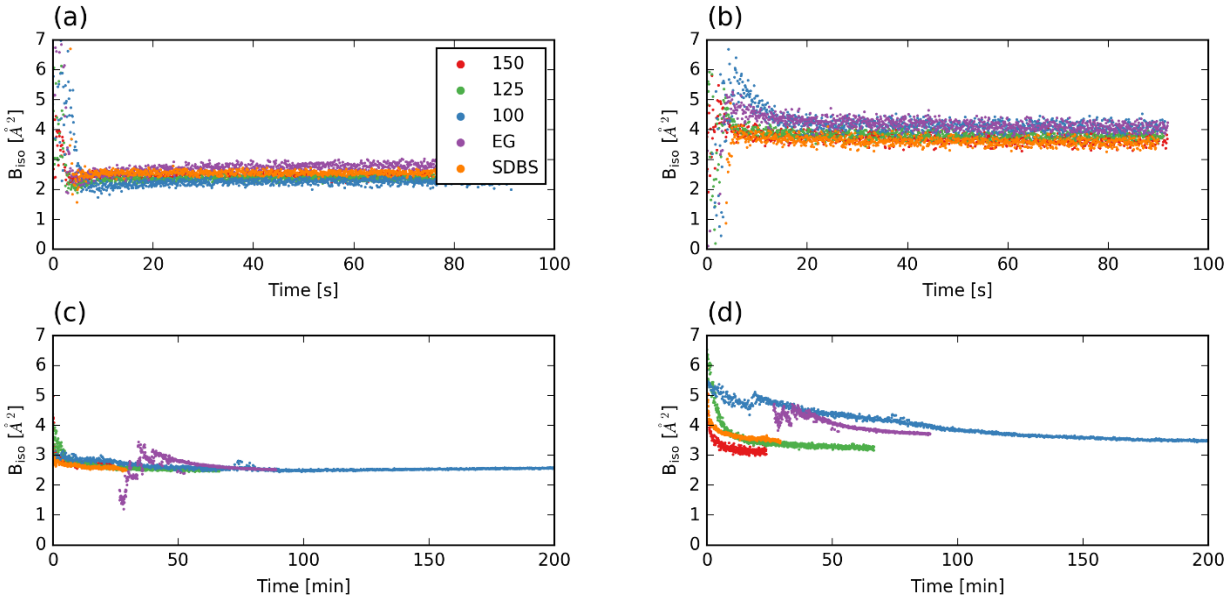


**Figure S3:** Refined atomic displacement parameters for (a-b) Ti-slurry, and (c-d) Ti-CAsol experiments. (a) refined $B_{iso}$ values for Ba; (b) refined $B_{iso}$ values for Ti; (c) refined $B_{iso}$ values for Ba; (d) refined $B_{iso}$ values for Ti. Color-coding is as described in (a) for all panels.

**Fits to the Johnson-Mehl-Avrami equation to the normalized scale factors**

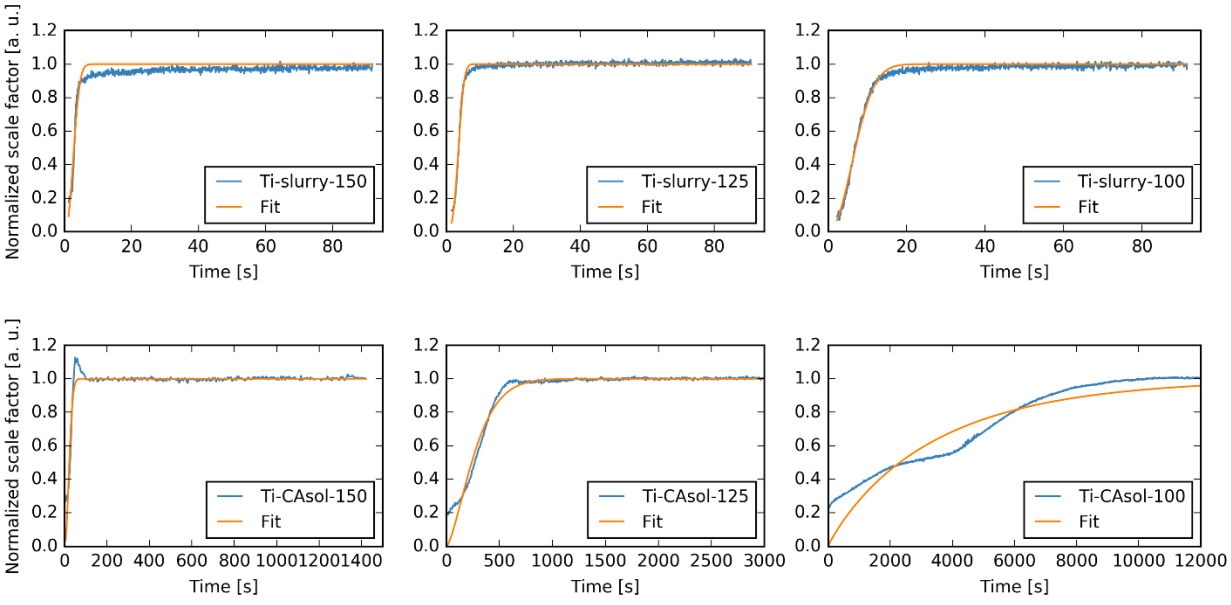


**Figure S4:** Normalized scale factor and fit to the Johnson-Mehl-Avrami equation for all samples used for the kinetic modeling.

**Summary of the final refined values for all experiments**

Isotropic Lorentzian strain and size parameter, lattice parameter, and $B_{iso}$ for Ti and Ba for $BaTiO_3$ were refined. Scale factor was refined for $BaCO_3$ (for Ti-CAsol-100 and Ti-CAsol_EG) for the batch refinement, keeping size and lattice parameters fixed to the values refined in the last frame (frame with the most $BaCO_3$).

**Table S1:** Refined values (size, strain, lattice parameter, atomic displacement parameters for Ti and Ba and R-values) for the last frame from each experiment. Refinements were done using space group no. 221, Pm-3m, for $BaTiO_3$.

| Sample | Crystallite size [nm] | Strain [$10^{-3}$] | Lattice parameter [Å] | Ti $B_{iso}$ [$Å^2$] | Ba $B_{iso}$ [$Å^2$] | $R_{wp}$ [a.u.] | $R_{bragg}$ [a.u.] | Amount $BaCO_3$ [wt %] |
|---|---|---|---|---|---|---|---|---|
| Ti-slurry-100 | 14.3(4) | 1.27(7) | 4.0612(3) | 3.99(9) | 2.39(6) | 2.14 | 0.99 | 0 |
| Ti-slurry-125 | 15.0(4) | 1.25(6) | 4.0603(3) | 3.78(8) | 2.31(5) | 1.89 | 1.02 | 0 |
| Ti-slurry-150 | 15.6(2) | 0.94(3) | 4.0587(2) | 3.73(5) | 2.49(3) | 1.01 | 0.96 | 0 |
| Ti-slurry-EG | 8.7(2) | 0.76(8) | 4.0632(4) | 4.23(8) | 2.82(6) | 1.99 | 0.76 | 0 |
| Ti-slurry-SDBS | 25.0(7) | 0.60(4) | 4.0531(2) | 3.67(7) | 2.59(4) | 1.99 | 1.27 | 0 |
| Ti-CAsol-100 | 13.9(3) | 0.86(5) | 4.0540(2) | 3.48(6) | 2.56(4) | 1.80 | 1.13 | 12 |
| Ti-CAsol-125 | 12.6(1) | 0.67(3) | 4.0505(1) | 3.29(4) | 2.54(3) | 1.20 | 0.97 | 0 |
| Ti-CAsol-150 | 12.5(2) | 0.63(5) | 4.0507(2) | 3.04(6) | 2.72(4) | 0.90 | 0.67 | 0 |
| Ti-CAsol-EG | 13.4(2) | 0.84(4) | 4.0504(2) | 3.68(5) | 2.53(3) | 1.30 | 0.93 | 5 |
| Ti-CAsol_SDBS | 10.7(1) | 0.76(4) | 4.0530(2) | 3.48(5) | 2.51(3) | 1.30 | 0.70 | 0 |