Unidirectional Freezing of Ceramic Suspensions: In Situ X-ray Investigation of the Effects of Additives

Benjamin Delattre,* Hao Bai, Robert O. Ritchie, Joël De Coninck, Antoni P. Tomsia

Materials Sciences Division,
Lawrence Berkeley National Laboratory,
Berkeley, CA 94720, USA
*To whom correspondence should be addressed: bdelattre@lbl.gov

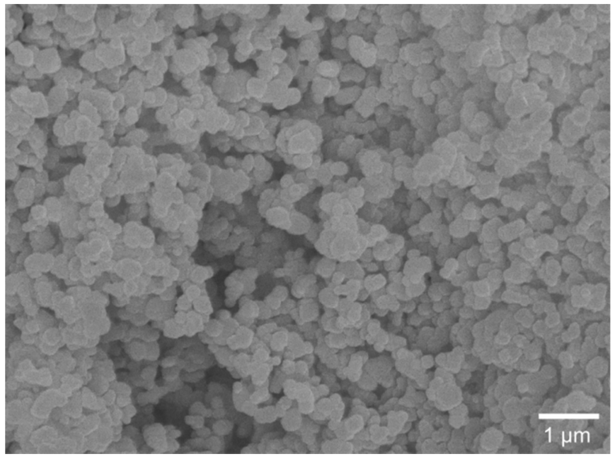

Figure S1: SEM image of TiO_2 powder after 20h of ball-milling.

Video S1: X-ray radiography video of slurry S1 which contains only 0.5 wt.% of dispersant. A fraction of the particles was rejected ahead of the ice front, creating a dense layer that became thicker as freezing progressed (250 microns at 4 mm from the bottom of the mold). The other fraction of the particles was periodically entrapped, leading to the formation of horizontal ice-banding patterns that are reminiscent of ice-lens patterns.

Video S2: X-ray radiography video of slurry S2 which contains 0.5 wt.% of dispersant and 2 wt.% of binder. Particles are thoroughly redistributed in between ice-crystal tips. Although a lamellar freezing regime is observed, the ice crystals appeared to partially retain a dendritic shape.

Video S3: X-ray radiography video of slurry S10 which contains 0.5 wt.% of dispersant and 0.1 wt.% of binder. Particles are entrapped or expelled randomly with the result that a thick buildup of particles is formed ahead the ice front.

Video S4: X-ray radiography video of slurry S15 which contains 0.5 wt.% of dispersant and 1.5 wt.% of binder. A lamellar freezing regime appears after the fast-growth regime.