

# Nucleation and Growth of Crystalline Carbonates from Amorphous Precursors

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## Abstract

Biomining organisms routinely assemble materials with sophisticated design and advanced functional properties, often using amorphous precursors to access compositional and structural states far from equilibrium. Organic macromolecules and inorganic additives such as magnesium ion are thought to play an important role in controlling phase transformations in these systems. However, it has proven extremely challenging to accurately describe pathways and determine mechanisms, even for extensively studied system such as amorphous calcium carbonate (ACC). I will discuss recent work in my laboratory in which we use liposomes<sup>[1]</sup> and microfluidic droplets as nano-to-microscale reactors to study the impact of confinement,<sup>[2]</sup> biomolecules, and inorganic additives on the kinetics of crystallization of ACC and its barium-substituted derivative (ACBC). In the course of this work, we discovered bulk syntheses leading to two other metastable, yet crystalline carbonates that we call balcite and gortatowskite.<sup>[3]</sup> Balcite is isostructural with a high temperature modification of calcite and has exceptional hardness; its kinetics of formation hint on a complex, possibly non-classical mechanism. Gortatowskite on the other hand is a barium carbonate monohydrate that crystallizes in quasi-two-dimensional habit. These findings demonstrate that microfluidic devices are a powerful tool in the study of phase transformations of the rich-chemistry of metastable carbonates.

## Short Biography

Derk Joester is originally from Munich (Bavaria, Germany) and studied Chemistry in Tübingen. He travelled to the US on a Fulbright Scholarship to study Chemistry and Biochemistry, and then went on to get his Diploma in Organic Chemistry at ETH Zurich, Switzerland, in 1998. He received his Ph.D. for work carried out in organic, supra-molecular chemistry with Prof. François Diederich at ETH Zurich in 2003, and in the same year became a Postdoctoral Fellow at Weizmann Institute of Science in the lab of Prof. Lia Addadi in the Department of Structural Biology. From 2005-2007 he continued his research at the Weizmann Institute as a Minerva Fellow. In September 2007 he accepted a position at the Materials Science & Engineering Department at Northwestern University, Evanston, Illinois. In 2013, he was promoted to Associate Professor. His research interests include biological mechanisms of crystal growth, the role of organic/inorganic interfaces and confinement in phase transformations, metastable precursor phases, and the structure and properties biomaterial-organic composites with hierarchical architectures.



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