Journal of
Structural Chemistry & Crystallography Communication

Abstract

Layered Structures in Biogenic Magnesium Calcite Single Crystals

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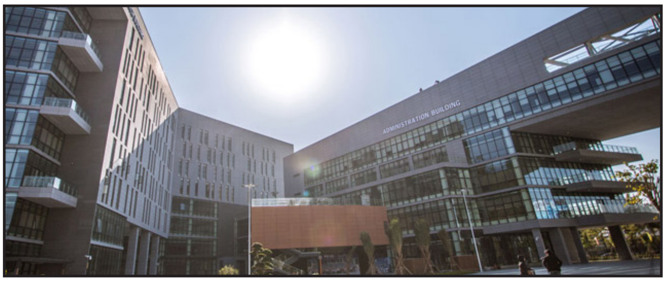
Abstract:
Some calcitic biominerals have been shown to be formed through the crystallization of a Mg-rich amorphous calcium carbonate (Mg-ACC) precursor. Formation mechanisms of multiscale biogenic single crystal structures at ambient temperatures, in conditions of limited solid phase diffusion, remain largely incomprehensible. Based on experimental results, we develop a model describing the formation of the brittle star Mg-calcite nanostructure from an amorphous Mg-ACC precursor to a Mg-calcite nanostructure containing periodic layers with varying concentrations of coherent Mg-rich nano-inclusions. The formation route is rationalized in a two-step model: the first step involves spinodal decomposition of a liquid or gel-like Mg-ACC precursor into Mg-rich nanoparticles and a Mg-depleted amorphous matrix. The second step is the crystallization of the decomposed Mg-ACC precursor. The crystallization of Mg-depleted ACC matrix is accompanied by the exclusion of Mg ions into a diffusion zone adjacent to the crystallization front; after crystallization of a certain layer, the Mg concentration ahead of the layer exceeds the critical value above which the Mg-ACC matrix becomes unstable against spinodal decomposition. A secondary spinodal decomposition will then start and result in the formation of additional Mg-rich nano-domains. As a result, the density of Mg-rich nano-domains changes periodically and forms periodic layered structure inside magnesium calcite single crystals. The model was supported by our experimental results in synthetic Mg-calcite, which suggest a spinodal decomposition in the amorphous precursor. These new insights have significant implications for fundamental understanding of the role of Mg-ACC material transformation during crystallization and its subsequent stability.

Biography:
Alexander Katsman has completed his PhD at the age of 29 years from Ural State Technical University, Russia. He is the senior researcher of Department of Materials Science and Engineering in Technion – Israel Institute of Technology. He has published more than 80 papers in



reputed journals.

Publication of speakers:
1. Lang, Arad & Polishchuk, Iryna & Seknazi, Eva & Feldmann, Jochen & Katsman, Alexander & Pokroy, B.. (2020). Bioinspired Molecular Bridging in a Hybrid Perovskite Leads to Enhanced Stability and Tunable Properties. Advanced Functional Materials. 2005136. 10.1002/adfm.202005136.
2. Lang, Arad & Mijowska, Sylwia & Polishchuk, Iryna & Fermani, Simona & Falini, Giuseppe & Katsman, Alexander & Marin, Frédéric & Pokroy, B.. (2020). Acidic monosaccharides become incorporated into calcite single crystals. Chemistry. 10.1002/chem.202003344.
3. Lang, Arad & Mijowska, Sylwia & Polishchuk, Iryna & Falini, Giuseppe & Fermani, Simona & Katsman, Alexander & Marin, Frederic & Pokroy, B.. (2020). Acidic monosaccharides become incorporated into calcite single crystals. 10.1101/2020.08.03.234310.
4. Mijowska, Sylwia & Polishchuk, Iryna & Lang, Arad & Seknazi, Eva & Dejoie, Catherine & Fermani, Simona & Falini, Giuseppe & Demitri, Nicola & Polentarutti, Maurizio & Katsman, Alexander & Pokroy, B.. (2020). High Amino Acid Lattice Loading at Nonambient Conditions Causes Changes in Structure and Expansion Coefficient of Calcite. Chemistry of Materials. XXXX. 10.1021/acs.chemmater.0c00428.

Webinar on Materials Science and Nanotechnology

Citation: Alexander Katsman; Layered Structures in Biogenic Magnesium Calcite Single Crystals; Euro Materials 2020; July 27, 2020; London, UK