

Understanding the Formation Mechanism in Solution Crystallization of Mesocrystals. A Dialog of Theory with Experiment

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Abstract

A central topic in material research fields is the processes by which crystals nucleate, grow and form in solution. Understanding the fundamentals of these processes is crucial to achieve control over the size, purity, morphology, and crystal structure. This research area is located in the intersection between fundamental science investigations and technological applications. Here, we present and discuss the progress and challenges as well as the shortcomings associated with the analysis of these processes and review studies contributing to the development of the modern models. The works have been developed at LIEC.

We focus on the microwave assisted hydrothermal method as a green and sustainable approach to synthesize materials such as mesocrystals. Both CuO with sea urchin morphology and CaTiO₃ perovskite have been selected as case study. In particular, the entire sequence of crystallization events of CuO was monitored by scanning transmission electron microscopy (STEM) in combination with transmission electron microscopy (TEM), high resolution transmission electron microscopy (HRTEM) and, X-ray diffraction (XRD) patterns. In addition, photoluminescence emission spectrum is used to measure the CaTiO₃ mesocrystal formation, while XRD patterns were used to validate the CaTiO₃ phase, as well as their architecture was directly verified from SEM analysis.

