

Tracking the temporal evolution of Ostwald ripening in CaCO₃ crystals, related to phenomena observed under CO₂ storage.

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Calcium carbonate (CaCO₃) cost the heating industry tremendous amounts each year, as it lowers heating efficiency. It is the most abundant carbonate-bearing mineral and it is found both as a byproduct of microbial activity and in anthropogenic production systems. From a scientific point of view, CaCO₃ has served as a model system, for nucleation pathways, crystal growth, and surface deposition. CaCO₃ was the first mineral, that broke with the paradigm of classical nucleation theory, as it was found that its nucleation is facilitated by an amorphous calcium carbonate (ACC) phase. This phase has been identified and studied, and by changing the parameters of the synthesis, the energy needed to create polymorphs of CaCO₃ has been understood from the stability of the ACC phase.

In our work, a standard method of dynamic light scattering (DLS) is used to map the kinetics of the CaCO₃ evolution. As CaCO₃ can be synthesized by multiple pathways, 3 sets of reactants, were investigated, and the effect of saturation and stirring speed on the kinetics of CaCO₃ formation was correlated. It was showed that when synthesized by the first set of reactants there is a coexistence of 2 phases, which over time merged into one phase, giving insight to the process called Ostwald ripening. The temporal evolution of this was tracked. Under synthesis conditions with CO₂ saturated brine, these phases did not exist, and only one phase could be identified, which over time grew larger, supporting a ripening of the crystals with time. The sizes of the CaCO₃ was further measured with scanning electron microscopy, which was used as a calibration for the DLS measurements. These results give valuable insights into the formation kinetics of CaCO₃, and the temporal evolution and ripening of the competing crystal phases.