Microfluidic spray-drying:
A tool to study early stages of the mineral formation?

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Recent experimental results provide ample of evidence that the pathway minerals, such as $CaCO_3$, are formed depends on the synthesis conditions. As a result, the structure, morphology, and size of the minerals depend on the synthesis conditions. However, our understanding of these complex formation pathways is still incomplete, such that the morphology and structure of minerals produced in the laboratory cannot be controlled with the same precision as when produced by nature. For example, we are only starting to understand the influences of the synthesis conditions on the structure of ion clusters and mineral particles that form during very early stages and how these structures influence those of the evolving minerals. To investigate this correlation in more detail, we developed a microfluidic spray-dryer that forms 100 μm diameter airborne drops and subsequently breaks them into many much smaller drops that can be dried in less than a millisecond. This device enables us to very rapidly quench reactions and opens up possibilities to characterize the structure of particles that form during very early stages. In this talk, I will show how synthesis conditions influence the structure of $CaCO_3$ particles that form in aqueous drops during very early stages. Moreover, I will present data on the structure and morphology of much simpler inorganic materials, such as monovalent salts, that were very rapidly dried with the microfluidic spray-dryer.