In-situ Raman microspectroscopy study of calcium carbonate crystallisation

Natercia Barbosa

natercia.barbosagoncalves@unige.ch

The formation of biogenic $CaCO_3$ has fascinated scientists for decades. Living organisms can select specific polymorphs and use them to build complex morphologies for biological functions, as seen in corals, coccoliths, bivalves, and many other systems. As a result, $CaCO_3$ crystallization pathways have been extensively investigated in both biomineralization and in vitro studies. However, the resulting observations diverge from studies to studies, which led to debates among the community. Several crystallization pathways are then proposed, for which classical and non-classical theories often compete to describe them.[1]

To bridge the divergences observed, using optical microscopy and Raman microspectroscopy, we have recently stressed the complexity of $CaCO_3$ crystallization and its strong dependence on initial conditions.[2] By following the precipitations *in situ* over a wide range of supersaturations, we demonstrated that several pathways coexist in solution. The appearance of metastable phases could be retarded at lower supersaturation, while calcite crystals could consistently form upon mixing. This study highlighted the importance of mesoscale study to complement bulk and nanoscale studies. To gain further details of polymorphic transformation, we currently monitor individual crystallization events at high temporal resolution. This is achieved by inducing $CaCO_3$ nucleation through localized heating using a near infrared (NIR) laser [3] while Raman microspectroscopy is performed *in situ* to follow the spectral evolution of one single event in real time. This approach will provide new spectroscopic insight into the $CaCO_3$ crystallization pathway.

References:

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