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Enzyme mediated calcium carbonate crystallization in the presence of natural polysaccharide

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Calcium carbonate ($CaCO_3$) is the most abundant type of biomineral, which is readily available in nature mainly in the structural components of the living organisms. Synthesize of the biominerals in the living organisms is mainly associated with organic macromolecules. These organic materials play an important role in nucleation, growth and the morphology controls of the biominerals. On the other hand, biomineral formation can be artificially accelerated by enzyme. Concept is called enzyme mediated biomineralization. Urease enzyme has ability to hydrolysis of the urea to produce ammonia and carbonate ions which tend to precipitate $CaCO_3$ in the presence of calcium ions. In this research, concept of enzyme mediated biomineralization was implemented to produce biominerals artificially in the presence of chitosan which is the one of the most abundant natural polysaccharide available in nature.

Experiments were done by using commercially available urease enzyme and chitosan solution was prepared by dispersing solid chitosan in 1% acetic acid solution, followed by adjusted to pH by using NaOH. Experiments were conducted at different urease concentrations in the presence (0.03%) or absence of the chitosan. Same experiments were conducted under the different chitosan concentrations (0-0.15%) with a urease concentration of 0.3 U/ml. Morphologies of formed $CaCO_3$ crystals were analyzed by Scanning Electron Microscope.

Amount of $CaCO_3$ precipitate increased with urease concentration in the presence or absence of the chitosan. The amount of precipitate in the presence of chitosan was higher than that in the absence. According to the SEM images, spherical shape crystals of $CaCO_3$ are dominant without chitosan and rhombohedral crystals are dominant with chitosan, which would act as a binder to form rhombohedral crystal agglomeration. We also found that chitosan concentration has a significant influence on the amount of precipitate.