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Development of Calcium Carbonate Molecular Sheets via Wet Chemical Route

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Abstract : The interaction of organic and inorganic matrices of biological origin resulting in self-assembled structures with unique properties is well established. The development of such self-assembled nanostructures by synthetic and bio-inspired techniques is an established field of active research. Among bio-materials, nacre, a laminar stack of calcium carbonate nanosheets, which are interleaved with organic material, has long been focused research due to its unique mechanical properties. In this paper, we present the development of nacre-like lamellar structures made up of calcium carbonate via a wet chemical route. We used the binding affinity of carboxylate anions and calcium cations using poly (acrylic) acid (PAA) to lead $CaCO_3$ crystallization. In these experiments, we selected calcium acetate as the precursor molecule along with PAA (Mw ~ 8000 Da). We found that Ca^{+2}/COO^{-} ratio provided a tunable control for the morphology and growth of $CaCO_3$ nanostructures. Drop casting one such formulation on a silicon substrate followed by calcination resulted in co-planner, molecular sheets of $CaCO_3$, separated by a spacer layer of carbon. The scope of our process could be expanded to produce unit cell thick molecular sheets of other important inorganic materials.

Keywords : self-assembled structures, bio-inspired materials, calcium carbonate, wet chemical route
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