Biologically inspired Dendrimer Nanocomposite Materials

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Biomineralization processes often produce interesting phases of materials under ambient conditions. Unicellular plankton known as diatoms are able to produce ornate nanostructures of silica at ambient conditions. In contrast, current materials approaches require extremes of temperature and pH. Diatoms are able to biomineralize the silica using species specific peptides known as silaffins that possess lysine residues heavily post-translationally modified with polyamines. The polyamines are the active moiety that drives the condensation of silicic acid to silica. At neutral pH, the parent non post-translationally modified R5 peptide is also capable of producing silica. A clear understanding of how these long chained branching structures drive silica formation would provide important insight to the biological systems unique control over silica and provide a route for expanding its use in the condensation of other materials of interest such as the semiconducter TiO2 or the piezoelectric material gallium phosphate. Additionally, we report the use of amine-terminated PAMAM dendrimers as effective mimetic templates for silica condensation. By capitalizing on the dendrimer's host guest properties, they provide novel templates for the production of larger more sophisticated structures of biomimetic silica with novel functionality and applications in supported heterogeneous catalysis, biocatalysts, and as biological probes.