BIOMIMETIC SYNTHESIS AND ASSEMBLY OF NANOPARTICLE AND NANOCELLULOSE HYBRIDS

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Abstract

The ability to control structure and functionality at all length scale has developed tremendously in the last decades. While traditional solid state chemistry has perfected the design of materials at the atomic scale where the chemical composition and the atomic structure are of fundamental importance for the properties and functionality of the desired material, it is clear that optimal design of nanostructured materials require integration of various approaches to synthesize, functionalize, characterize and process the nanosized species for various applications. Examples will be given how bio-inspired synthesis and assembly can offer a high degree of versatility, simplicity and flexibility in the production of bulk materials and coatings and allows the introduction of specific functions.

We will demonstrate how self-assembly of surfactant-capped inorganic particles can result into ordered arrays with both translational and orientational order, and elaborate on the requirements for successful deposition of textured nanostructured oxide films on substrates. The possibility to assemble iron oxide nanocrystals into superlattices with a pronounced long-range order will be demonstrated and related to the magnitude, range, direction and duration of the intrinsic and induced interparticle forces [1, 2]. Recent attempts on how lipid-coated mesoporous silica particles can be designed for controlled uptake of ions through the incorporation of membrane proteins will also be presented [3].

Our recent work on the fabrication of multifunctional materials based on nanocellulose and different classes of nanoparticles will also be demonstrated. The impact of different approaches used for the fabrication of the hybrids on the magnetic, mechanical, and optical properties will be elucidated. Hybrids composed of bacterial nanocellulose and $CoFe_2O_4$ nanoparticles can be prepared both as a stiff magnetic nanopaper or a flexible magnetic aerogel by adjusting the freeze-drying conditions [4]. Hybrids based on nanocellulose crystals and amorphous calcium carbonate results in a stiff and brittle nanopaper, where the system can be tailored to mimic synthetic nacre-like structures [5].

Selected references:

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