"Integrative bio-inspired Materials Chemistry: A domain where chemistry, biologie, physics and engineering meet"

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Mother nature knows since the dawn of time how to tailor-made functional hybrid materials. Hybrid inorganic-organic materials can be broadly defined as synthetic materials with organic and inorganic components which are intimately mixed. They can be either homogeneous systems derived from monomers and miscible organic and inorganic components, or heterogeneous and phase-separated systems where at least one of the components' domains has a dimension ranging from a few Å to several nanometers. Hybrid phases can also be used to nanostructure or texture new inorganic nanomaterials (porous or non porous). The versatile synthetic conditions provided by bottom-up strategies such as reactive molecular precursors or clusters, tunable processing temperatures and solvents and the adjustable rheology of the colloidal state allow for the mixing of the organic and inorganic components at the nanometer scale in virtually any ratio. These features, and the advancement of organometallic chemistry and polymers and sol-gel processing, make possible a high degree of control over both composition and structure (including nanostructure) of these materials, which present tunable structure-property relationships. This, in turn, makes it possible to tailor and fine-tune properties (mechanical, optical, electronic, thermal, chemical…) in very broad ranges, and to design specific systems for applications. Hybrid materials can be processed as gels, monoliths, thin films, fibers, particles or powders or can be intermediates to design materials having complex shapes or hierarchical structures. The seemingly unlimited variety, unique structure-property control, and the compositional and shaping flexibility give these materials a high potential in sensing, membranes, catalysis, biocatalysis, photocatalysis, nanomedicine, the tailoring of smart functional surfaces etc…. This lecture will describe some recent advances on this bio-inspired integrative materials chemistry that allows via a chemistry-process coupling to tailor made nanostructured and hierarchically structured functional inorganic and hybrid materials. Some of their properties will also be discussed. For more information see few recent reviews :

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Bio-inspired hybrid materials synthesized via " Chimie Douce":
A cornucopia where creativity of chemists can be expressed at best