SOL-GEL BIOPOLYMER / SILICA NANOCOMPOSITE IN BIOTECHNOLOGY

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Abstract

Many biocomposites associating natural macromolecules and silica have a great potential applications in biotechnology and medicine.
These biocomposites can be obtained either by the silification of a preformed biopolymer-based material or from silica precursors / biopolymer mixed solutions.
Herein,we describe the synthesis novel biocomposites with the processes using silicon alkoxide TEOS and aqueous silicates through the controlled association of peptine.

The system consists of hybrid gels obtained from peptine / TEOS and peptine silicate.
The substitution of alkoxide by silicate is challenging ,as the reactivity of aqueous precursors towards bio-polymer (peptine) may strongly differ from that of organosilanes,leading in many instances to the precipitation of silica / biopolymer aggregates rather than to bulk material formation. In both cases , the identification of the mechanisms by which silicates can interact with negatively charged biopolymer (peptine) would significantly extend the range of macromolecules that could be associated with silicates for a rational design of functional biocomposites.

We show that peptine can interact with these silicon alkoxide (TEOS) and silicate solution and form hybrid silica / biopolymer materials.

Infra-red spectroscopy and thermogravimetric analyses indicate that the silica polymer interface is controlled by hydrogen bond formation.

In both cases , the formation of hydrogen bonds with the biopolymer is suggested to be responsible for the cohesion of the composite structure.
Overall , these results indicate that aqueous silicates are attractive alternative precursors to silicon alkoxide for the design of hybrid materials in the context of green material chemistry and more specifically well adapted to aqueous sol-gel routes for the design of novel biocomposites.
In the first part , the synthesis and characterization of these biohybrid materials are described emphasizing the importance of the polymer influence on the reactivity of silica precursors. In the second part , the benefits of biopolymer incorporation in silica gels are illustrated in the context of biotechnological devices.

Keywords : silica , biopolymer , sol-gel , biotechnology