

From inter-crosslinked bio-hybrid gels to carbohydrate grafted multilayered siloxane nanoparticles.

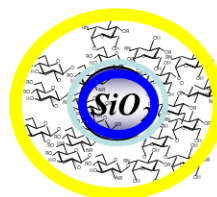
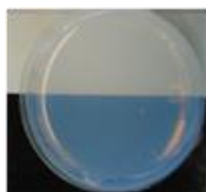
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Graphical Abstract



Hybrid Cross-linked PS/siloxane hydrogel PS nanoparticles Multilayer hybrid nanoparticles

Abstract

The purpose of the research presented here was to explore different possibilities in synthesizing polymeric hydrogel structures of defined sizes from nano-sized natural polymer molecules such as polysaccharides (PS) and hybrid mineral-organic silica nanoparticles. Water soluble linear or branched PS are nano-sized molecules that can be cross-linked to create larger hydrogel scaffolds at any desired micro or macro-size. Firstly 20-100 nm nanoparticles with an amorphous silica core and a reactive organic shell were synthesized and crosslinked by classical sol-gel processes. The inter-crosslinking of silica nanoparticles with polysaccharides was carried out in three different ways: by trapping the polysaccharides in a dense network of crosslinked silica nanoparticle; by co-crosslinking the chemically modified PS with the reacting nanoparticles and by using the modified polysaccharide as the cross-linker. These processes resulted in bio-hybrid mineral/organic hydrogels. Using similar chemistry multi-layered nano-particles were synthesized. These nanoparticles were made of a central amorphous mineral silica core covered by a hydrophobic organic layer. This organic layer contained reactive epoxy groups onto which a hydrophilic oligosaccharidic surface was grafted. In order to react the oligosaccharidic moiety onto the nanoparticle diethylamine was added by reductive amination onto the reducing hemiacetal function of a reducing oligosaccharide. The remaining amino group of the resulting modified sugar derivative was then attached on the nano-particles by reacting with the pending epoxy groups at the nanoparticle surface. On these multilayered nanoparticles some epoxy groups remained buried underneath the bulky oligosaccharidic external layer. Those were reacted with amine bearing molecules such as methylene blue. Purification of the obtained multilayered nanoparticles was easily performed by ultrafiltration. These three examples show the numerous possibilities of creating specific hydrogel polymeric structures at various sizes with specific functionalities by using different chemistry.

Keywords: microcapsule; microparticle; nanoparticle; hydrogels; crosslinked polysaccharide; multilayer; sol-gel process.

Acknowledgements

We wish to acknowledge the region Champagne Ardenne, CNRS and Reims University the funding and research supports.

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