Promising Tailor Made Nanocapsules Based on Biopolymer For Antibiotic Therapy

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Abstract

Recent progress in supramolecular chemistry leads to unparalleled control over the composition and shape factor of colloidal systems. Among them, the design of hollow capsules is a new expanding area of physical-chemical research.[1] Herein, we report on the preparation of ultra-low sized (< 100 nm in diameter) biodegradable polymeric capsules for potential applications as nanocontainers in antibiotic therapy. Hollow nanospheres based on the chitosan/poly (acrylic acid) pair are elaborated *via* (*i*) the layer-by-layer technique[2,3] using gold nanoparticles (20 and 60 nm in size) as sacrificial templates,[4,5] (*ii*) loading with amoxicillin, a betalactam antibiotic, and (*iii*) removal of the gold core via cyanide-assisted hydrolysis (figure 1). Size, dispersity and concentration of the resulting nanocapsules are easily fixed by the nanoparticle templates, while wall thickness is controlled by the number of polyelectrolyte bilayers. Electrostatic interactions between the protonated amine groups of chitosan and the carboxyl groups[2] of poly(acrylic acid) act as the driving attraction force allowing easy and fast design of robust and well-ordered multilayer films. Successful hydrolysis of the gold core is evidenced by time-dependent monitoring of the gold spectroscopic signature (absorbance at 519 nm and 539 nm for the gold nanoparticles with 20 and 60 nm, respectively). Crosslinked capsules are also prepared through crosslinking of the chitosan chains with gluteraldehyde. Chitosan-based nanocapsules are finally evidenced to be promising drug delivery vehicles of amoxicillin trihydrate with tuneable properties such as entrapment efficiency in the range of 62-75 % and 3.5-5.5 % concerning the drug loading. The drug-loading content was up to 5%

Image

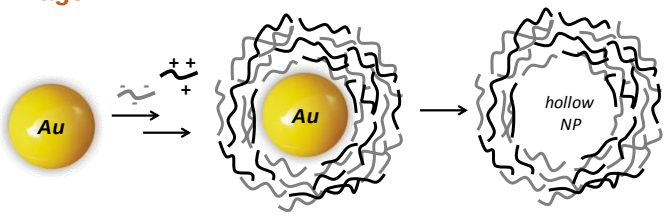


Figure 1. Schematic illustration of hollow nanocapsule elaboration by the polyelectrolyte layer by layer self-assembly strategy. (NP: nanoparticle)

Recent Publications (minimum 5)

1. Peyratout C.S, Dahne L (2004) , Tailor-made polyelectrolyte microcapsules: from multilayers to smart containers. Angewandte Chemie 43: 3762-3783.
2. Borges JO, Mano JF (2014) Molecular interactions driving the layer-by-layer assembly of multilayers, Chemical reviews 114: 8883-8942.
3. Nguyen TTT, Belbekhouche S, Dubot P, Carbonnier B, Grande D (2017) From the Functionalization of Polyelectrolytes to the Development of a Versatile Approach to Polyelectrolyte Multilayer Films with Enhanced Stability, Journal of Materials Chemistry A, 5:DOI 10.1039/C7TA06855G
4. Belbekhouche S, Charabi S, Picton L, Le Cerf D, Carbonnier B. (2018) Glucose-sensitive polyelectrolyte microcapsules based on (alginate/chitosan) pair *Carbohydrate Polymers,* 184: 144-153.
5. Jiang HX, Ding Y, Chen Q, Yang C (2004) Core-Template-Free Strategy for Preparing Hollow Nanospheres, Advanced Materials 16:933-937.



Biography

Sabrina Belbekhouche is an associate professor (east paris institute of chemistry and materials science/ University of Paris, France). Her core expertise is in polymer science, macromolecular assembly and surface modification. This includes the polymer synthesis; the study of the physical chemistry of surfaces/interfaces; and the use of controlled assembly at the sub-micrometer scale (nanoparticle, nanocapsule...) as well as stimuli-responsive systems. Current applications of her research are mainly for biological application.

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