

Investigation of hybrid silica-chitosan coating as controlled drug release model system

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Controlled drug release systems have been intensively investigated during the last decades as they may allow to reach a selectively localized, extended and this way highly effective drug release in the human body with reduced side effects. Porous silica and chitosan based systems separately are very promising candidates to be used in drug release systems.

Our purpose with this study was to form a hybrid, bi-layer system containing mesoporous silica and chitosan thin layers that can serve as a model system and enables to conveniently investigate its properties relevant for controlled drug release. The inorganic silica layer functioned as a drug storage layer, while the organic chitosan coating was present for controlling drug release. The thin layers were deposited onto glass substrate using the inexpensive and simple dip-coating technique.

The biopolymer coatings were cross-linked ionically (by sodium-triphosphate) and covalently (by glutaraldehyde), which was confirmed using attenuated total reflection Fourier transform infrared spectroscopy and scanning electron microscopy with energy-dispersive spectroscopy. In-situ

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spectroscopic ellipsometry was applied to determine the swelling ratio of native and cross-linked chitosan layers.

Rhodamine 6G cationic dye was used as model drug and its incubation into the mesoporous silica layer was studied at different incubation rate, time and pH. The release of model drug was investigated in phosphate buffer solution (pH =7.3) and to examine the responsive behaviour of chitosan in acidic (pH = 3) and basic (pH = 11) aqueous media.

The cationic dye was successfully incubated into the porous system and an accumulation of the dye was found. The role of electrostatic interaction, diffusion, and capillary forces in that process are discussed. Cross-linking the chitosan ionically and covalently resulted in a higher and in a lower swelling ratio, respectively, compared to native chitosan, while both coatings showed a retard effect in model drug release investigations at neutral pH.

The results and their interpretation provide information about the mechanism of incubation, accommodation and controlled release of model drug from porous silica through chitosan layer, and may facilitate the use of silica-chitosan hybrid coatings in controlled drug release.

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