

PREPARATION AND CHARACTERIZATION OF ANTIBACTERIAL COATINGS FROM SILVER CONTAINING CHITOSAN AND SEMICONDUCTOR MATERIALS

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Introduction

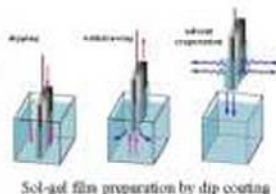
In recent years nanostructured wide gap semiconductors have received great attention. Oxide semiconductor thin films can be used in environmental applications (self-cleaning, antibacterial properties), sensors, solar cells, photocatalytic devices etc. Among various semiconductors TiO_2 is the most widely used because of its chemical stability, non-toxicity and relatively low cost. Chitosan is a cationic natural biopolymer that becomes an interesting biomaterial due to its good biocompatibility, biodegradability and antibacterial properties. Due to these properties and the possibility to cross-link it with ionic and non-ionic agents chitosan is applicable for controlled drug release. The aim of this work was to prepare and investigate thin layers with antibacterial properties from chitosan and inorganic materials applying the sol-gel method.

Synthesis of precursor sols

Silica and titania precursor sols were prepared in ethanolic media by the acid-catalyzed controlled hydrolysis of tetraethyl orthosilicate and tetrabutyl orthotitanate, respectively. Mesoporous coatings were prepared from precursor sols containing cationic (CTAB) or non-ionic (Pluronic PE 10300 triblock copolymer) surfactants. Silver containing TiO_2 precursor sols were prepared by adding AgNO_3 solution to the precursor sol or by mixing the precursor sol with the sol of Ag nanoparticles.

Preparation of coatings

Sol-gel films on glass substrates were prepared from the precursor sols by dip coating. Silver containing porous titania coatings were prepared by immersing the ready-made mesoporous supported coatings into AgNO_3 solution.

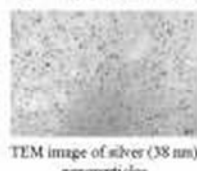


Chitosan films were prepared by dip-coating on glass substrates and porous silica coating surfaces as well. Silver containing chitosan composite films were prepared by mixing the previously synthesized stable silver sol with chitosan solution or by the preparation of silver nanoparticles directly in the chitosan solution.

Investigation methods

The average diameter of silver nanoparticles were determined by TEM measurements. The optical properties of the coatings were analyzed by UV-Vis spectroscopy.

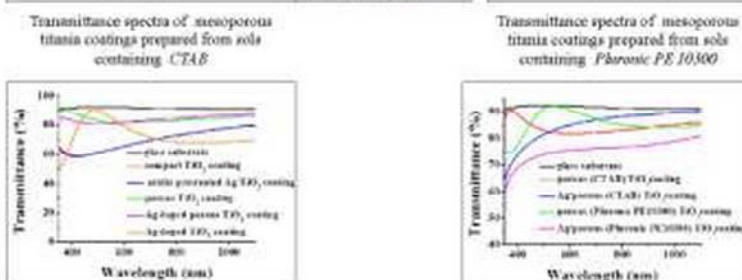
In the case of chitosan and combined porous silica sol-gel – chitosan films dye release investigations were carried out using UV-Vis spectroscopy. The antibacterial activity of titania coatings against *E. coli* bacteria was also studied.



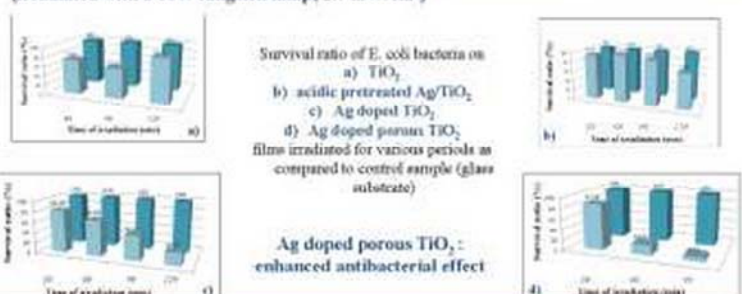
RESULTS

I. Titania coatings for antibacterial applications

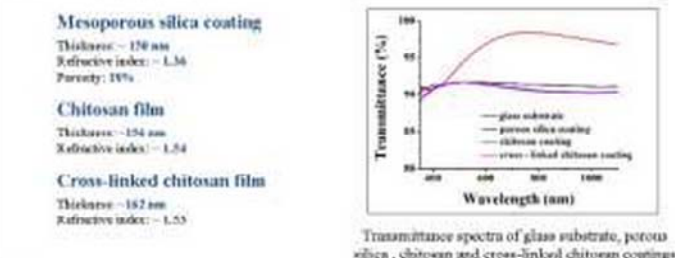
Mesoporous TiO_2 coatings and different types of silver containing TiO_2 films



Antibacterial activity of different types of titania coatings in visible light (irradiated with a 60W tungsten lamp; 2.7 mW/cm²)

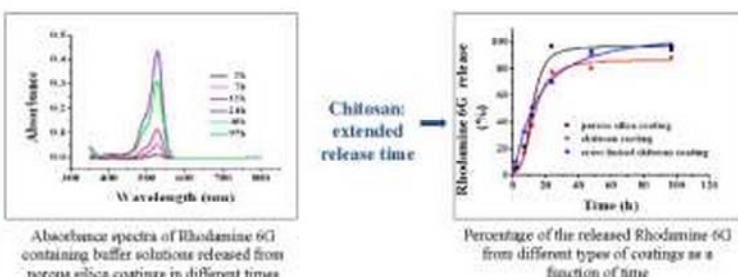


II. Chitosan and combined porous silica sol-gel – chitosan films



Dye release investigations

Dye release tests were carried out using 10^{-5} M Rhodamine 6G solution as model drug. Dye release of porous silica coatings at constant pH (pH=7.3) in buffer solution and the control of the release with chitosan and cross-linked chitosan films were studied.



Silver nanoparticle containing chitosan composite films

