# Eco- and biocompatibility of nano Ti, Mo, Zn coated chitosan film for medicine and electronics

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## INTRODUCTION

Materials based on natural polymers with metallic nanoscale coatings can be used to create biosensors and flexible green electronics [1, 2].

Chitosan is a biologically active natural polymer widely used in various fields of industry and medicine. It can be used to obtain nanoparticles as a reaction medium (chitosan works both as a size controller and as capping agent), as a dispersion medium for already obtained nanoparticles (functioning as a stabilizer), and as a substrate (metals can be incorporated into the surface chitosan film) [3].

In our work, Ti, Mo, Zn containing coatings were obtained on a chitosan films. On the film of chitosan (300 kDa, DD 87%) obtained by pouring onto a substrate and evaporating the solvent, the indicated elements were deposited by magnetron sputtering for 3-5 min using various carrier gases (nitrogen, oxygen). The thickness of the coatings was 10-30 nm.

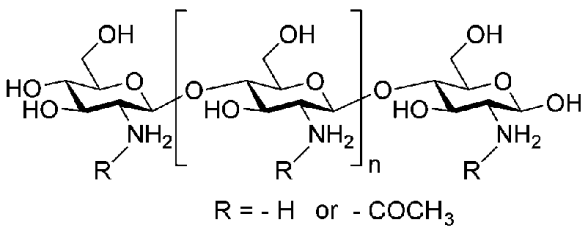


Fig. 1. The chemical structure of chitosan.

## MATERIALS AND METHODS

### *Film preparation*

For the film preparation acetic acid and chitosan with a molecular weight of 300 kDa and a degree of deacetylation of 82% (*China)* were used.

Acetic acid was added to a suspension of chitosan in water until the complete dissolution of chitosan. The solution was left for 24 h to dissolve and degass the chitosan and then poured onto Teflon substrates where the films were formed in course of the solvent evaporation (solution casting method).

### *Magnetron sputtering.*

Ti, Mo, Zn and their oxides and nitrides were deposited on the chitosan films by the method of high-frequency magnetron sputtering on chitosan substrates. Deposition was carried out at a high frequency discharge power of ~ 200 W at a frequency of 13.5 MHz in an argon, oxygen and nitrogen medium (depending on the desired coating) using targets of metallic Ti, Mo and Zn. The polymeric material was located on a rotating substrate holder. The sputtering time and the target-substrate distance were selected so as to minimize the effect of heating the substrate during sputtering.

Fig. 2. Installation of high-frequency magnetron sputtering

## RESULTS

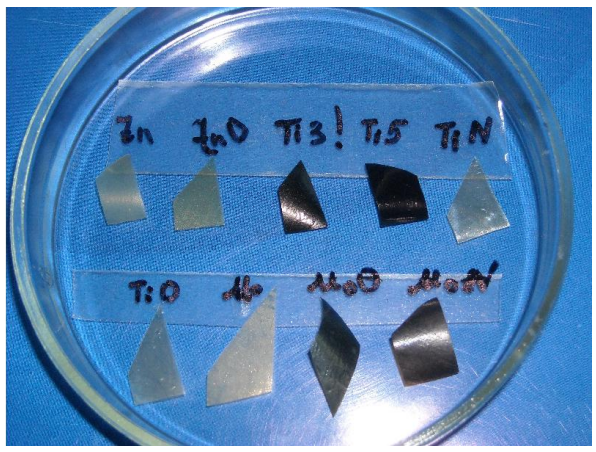


Fig. 3. Macroscopic view of deposited films

### *Film characterization*

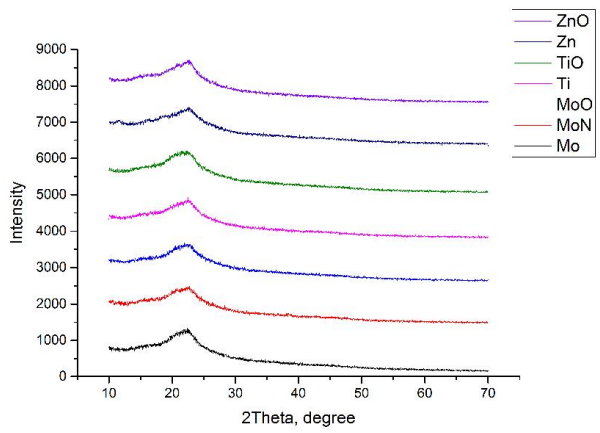


Fig. 4. XRD patterns of deposited films showing no crystal phases of corresponding deposited bulk material.

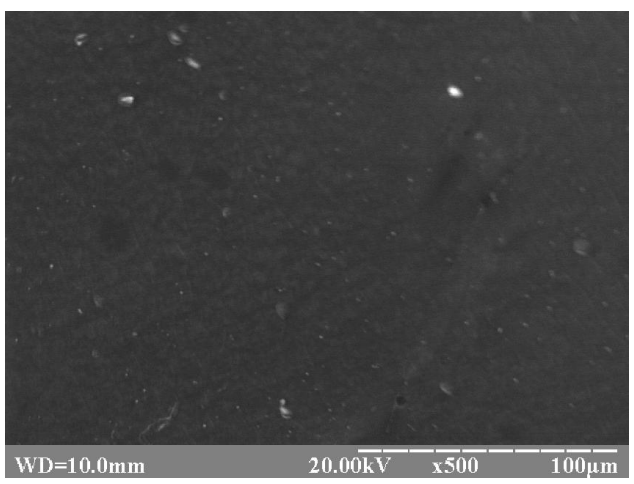


Fig. 5. SEM image of Mo-deposited chitosan film showing uniform surface.

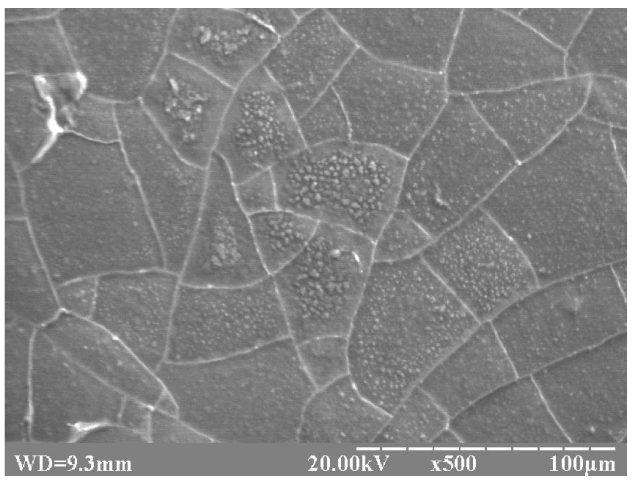


Fig. 6. SEM image of Mo-deposited chitosan film showing cracks on the MoO covered surface.

### Degradation in SBF and soil


Fig. 7. TiO- and MoN-coated chitosan films after 12 day degradation in soil.

## CONCLUSIONS

The work demonstrated the principal possibility of forming an ultrathin metallic, oxide or nitride coating without destroying the chitosan film and significantly changing its basic properties (swelling, degradability, etc.). Films degrade in biological media and soil in 5-12 days. Chitosan films with TiO, Mo, Zn, ZnO are characterized by a high light transmitting coefficient at 600 nm, 49.5 - 63.1%.

## REFERENCES

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