Polyelectrolyte multilayer thin films with antimicrobial properties

K. Szczepanowicz1*, T. Kruk1, M. Kolasińska1, J. Stefańska2, P. Warszyński1

1 J. Haber Institute of Catalysis and Surface Chemistry PAS, Niezapominajek st. 8, 30-239 Kraków, Poland
2 Medical University of Warsaw, Department of Pharmaceutical Microbiology, Oczki st. 3, 02-007 Warsaw, Poland
E-mail: ncszczep@cyf-kr.edu.pl

Development of new, effective and low cost antimicrobial agents has been an objective of research activity of many groups due to the build up of resistance of microbial organisms to traditional antibiotics. It is well known that silver or copper nanoparticles (Ag, Cu-NPs) are highly toxic to microorganisms. Silver and/or copper containing materials and coatings with antimicrobial activity can be used: in medicine to reduce infections in hospitals, in burn treatment, as well as to prevent bacteria and fungi colonization on prostheses, catheters, vascular grafts, dental materials, etc.

Polyelectrolyte multilayer thin films constructed using the “layer by layer” (LbL) technique proposed by Decher and co–workers have been widely studied in the recent years since the technique has the advantage of producing multilayer films with well-defined thickness and surface properties. Sequential adsorption of charged species like polymers and/or nanoparticles (NPs) has been demonstrated to be a versatile technique for the formation of multilayered thin films with a wide range of properties.

In the present work we focus on the synthesis of silver and copper nanoparticles as antimicrobial agents and on preparation of polyelectrolyte multilayer thin films containing such nanoparticles. Polyethyleneimine (PEI) was used as an anchoring layer. Then the multilayer was constructed with polyallylamine hydrochloride (PAH) as polycation and negatively charged silver or copper nanoparticle, which led to the formation of polyelectrolyte – silver or copper nanocomposite films. The obtained systems were studied using spectroscopic ellipsometry, scanning electron microscopy, quartz crystal microbalance and UV-Vis absorption spectrometry. We compared physicochemical properties of composite multilayer thin films prepared by two methodologies, dipping and spraying. We found that studied nanocomposite films have antimicrobial properties, which makes them very interesting for a number of practical application e.g. prevention of microbial colonization on treated surfaces.

The work was partially financed by 7 FP EU MUST project and MATERA ERA-NET NANOMEDPART project.