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Magnetron co-sputtered TiO_2/SiO_2/Ag thin coatings inhibiting bacterial adhesion and biofilm formation

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Protection of medical devices against infections is a significant current challenge raised by increasing number of medical devices associated infections and microbial resistance to conventional antibiotic and multi drugs treatments. Deposition of antimicrobial coatings is one of the current approaches to solution the problem.

The aim of this study was to develop protective coatings for medical devices with improved antibacterial activity, combining the known positive effects of TiO_2, SiO_2 and Ag nanoparticles, and employing magnetron co-sputtering as an ecology friendly and relatively easy technology. Magnetron co-sputtered TiO_2/SiO_2/Ag coatings with different Ag content were fabricated by varying the area of the Ag sheds at constant area of the TiO_2 target and SiO_2 sheds.

Surface characteristics, influencing the bioadhesion: chemical composition, topography, wettability and surface energy were estimated by SEM/EDX, XPS and contact angle measurement, respectively. The inhibitory effect toward bacterial growth on the new developed TiO_2/SiO_2/Ag coatings was tested using both, *E. coli* and *P. aeruginosa*. Bacterial biofilm formation in urine flow was evaluated for better characterization of the antimicrobial activity of these coatings.

SEM observation depicted a grain structure of the TiO_2/SiO_2/Ag composite coatings with homogeneous dispersion of the Ag nanoparticles. Significant antibacterial activity as well as reduced biofilm formation in urine flow were found: approaching to zero number of leaving *E. coli* and *P. aeruginosa* bacterial cells in the eluate detected after 1-3 h in contact with the studied coatings and significantly decreased, as compared to a silicon surface, biofilm formation after 24-48 h in urine flow.

Observed by SEM, direct contact killing and indicated by FAAS, released silver-mediated killing were proposed as a mechanism of antibacterial action of the studied coatings. Inhibiting bacterial adhesion and biofilm formation, as fabricated magnetron co-sputtered TiO_2/SiO_2/Ag coatings, are promising protection for medical devices as indicated by in vitro testing, including in flow.

Biography

Vladkova has her expertise in surface engineering starting as a member of a pioneering group in the development of brush type PEG coatings (Coll&Surf,1986) to create bioinert biomaterial surfaces, that do not cause non-desirable response reactions. Later she moves to bioactive biomaterials and material surfaces: bio-integrating biomimetic nanocomposites for bone tissue engineering; antimicrobial collagen based nanocomposites; marine biofouling preventing composition coatings; magnetron sputtered antibacterial coatings for medical devices, etc. Inhibition of bioadhesion and biofilm formation as well as surface characteristics, influencing biofouling (medical and marine) are in the focus of her investigations with a special emphasis on the non-toxic biofouling control including super hydrophobic surfaces utilization.

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