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Plasma Synthesis of Metal Nanoparticle-Loaded Polymer Films with Controlled Ion Release for Antibacterial Applications

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Antibacterial surfaces remain to be a hot topic for scientists as well as, increasingly, for general public. Bacteria-induced problems are of an utmost concern, especially in medicine and healthcare system where the presence of pathogens in hospitals, on medical instruments and accessories may cause lethal consequences. Recognizing the threat, in 2017 a World Health Organization issued a catalogue of priority pathogens, against which bactericidal agents are urgently needed [1].
A number of transition metals are known for their well-documented action against many bacteria. Despite extensive research, however, the mechanisms of the therapeutic effect are not precisely known. It is generally recognized that the introduction of metals in the ionic form may trigger off the bacteria killing pathways. Heterogeneous ion release from solid surfaces to aqueous media has become a method of choice, while nanostructuring has been suggested to enhance the release kinetics due to an increase of the specific area of the interface.
This work reviews the plasma-based methods of synthesis of metal nanoparticles (NPs) and their loading into plasma polymer matrices with a purpose of the fabrication of coatings effective against bacteria, including multidrug-resistant pathogens such as *MRSA* and *P. aeruginosa*. Particular attention is given to the use of magnetron-based gas aggregation cluster sources which allow for the direct incorporation of metal NPs as ready-made entities into plasma polymer matrices (Fig. 1). We aim to show that the bactericidal efficiency can be controlled by the number of embedded NPs as well as by the properties of plasma polymers. The combination of Ag or Cu NPs with fluorocarbon, organosilicon or polyether plasma polymers is analyzed with a special focus on nanoconfinement effects that exist at the metal/polymer interface and on their influence on the targeted properties of the coatings.

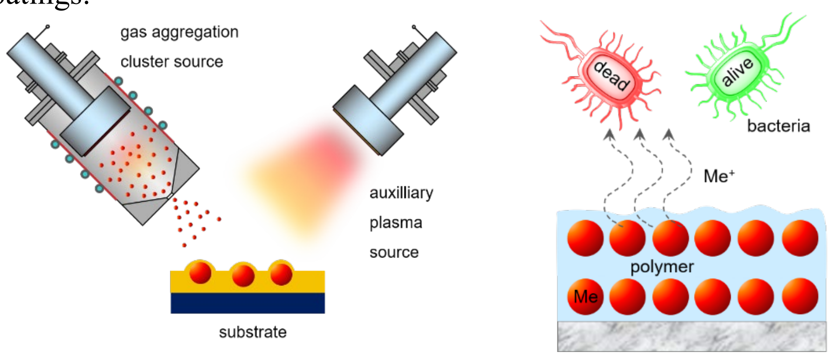

Fig. 1 Scheme of gas-phase aggregation of magnetron-sputtered NPs and their embedding into polymer matrices for controlled ion release.

References

[1] http://www.who.int