

DBD plasma assisted silver functionalization of surgical meshes

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Résumé

Atmospheric pressure diffuse barrier discharge in nitrogen was employed to promote the formation silver sub-micron particles on PP and PES warp-knitted surgical meshes. Its good antimicrobial efficacy against gram- positive *Stafylococcus aureus* and gram-negative *Escherichia coli* was confirmed.

Introduction

Owing to the substantial reduction of recurrence rate, the use of surgical meshes has become a standard procedure in hernia repair surgery throughout the world during last decade. At the same time however the mesh related problems, such as mesh-related infections, has risen into importance. One of approaches to prevent the mesh infection is to embed antimicrobial agents into the mesh, which prevent bacterial adhesion and further colonization when implanted into wound [1].

In our work we have attempted to prepare silver particles functionalized meshes. Silver ions are well recognized for their high toxicity for microorganisms while being is the least toxic metallic ion to animal cells [2]. To initiate the formation of cluster of silver atoms in solvent such as water, silver ion has to be first reduced down to the zero-valent state [3]. In our experiment radicals created by N₂ atmospheric pressure plasma treatment of mesh surface were employed as the reducing agents. The uniformity of created surface radicals was accomplished by generating plasma by diffuse mode of dielectric barrier discharge. It was found that the growth of silver atom clusters occurs preferentially on surface of surgical meshes yarns.

Surgical warp-knitted meshes made of PP monofilaments yarn and PES filaments were treated by 20 kHz, 100 Watt N₂ diffuse dielectric barrier discharge (APGD) for various treatment times. Immediately after the treatment, mesh samples were immersed into water solution of AgNO₃ of various concentrations and temperature. Quantitative analysis of immobilized silver was done by the potentiometric titration. Morphology of silver particles was studied by SEM. The antimicrobial efficacy of samples was evaluated in accordance with ISO 20645:2004, Textile fabrics - Determination of antibacterial activity - Agar diffusion plate test. The results showed that 2 min exposure to N₂ diffuse DBD, followed by 60 min dip in 0.05M AgNO₃ is sufficient to secure good antimicrobial efficacy against gram- positive *Stafylococcus aureus* and gram-negative *Escherichia coli*, with the inhibition zone greater than 1 mm (so called good effect). The reference samples without the treatment did not exhibit any antimicrobial activity.

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References

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