DEPOSITION OF SILVER NANOCOMPOSITE ON TEXTILES FOR CONTROLLABLE ANTIBACTERIAL ACTIVITY USING ATMOSPHERIC PRESSURE DIELECTRIC BARRIER DISCHARGE (DBD) PLASMA

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Abstract

Conventional antibacterial coatings by wet chemistry, low-pressure plasma and sputtering have several drawbacks but the most important is their uncontrollable antibacterial activity. The main objective of this work is to produce, by dielectric barrier discharge (DBD) plasma-assisted deposition at atmospheric pressure, a new generation of coatings containing silver nanoparticles (AgNPs) with controllable antibacterial activity on medical textiles. AgNPs was deposited by ultrasound-assisted, dip-coating, exhaustion at 30˚C and spray deposition methods. The deposited NPs were tuned using a "sandwich" coating structure where a 1st antibacterial nanocomposite layer is covered by a 5-50 nm thick 2nd polymeric layer in order to prolong antibacterial effect. A broad range of deposition parameters were investigated including plasma power, plasma gas, discharge gap, NPs type and size, types of precursor and textile substrate. The main advantage of this plasma-assisted deposition is its capability to produce, in a continuous process, coatings with strong bonding, high deposition rate and

precise release of antimicrobial agent by variation of coating composition and thickness. The ultrasound method displays an irregular distribution despite its local good deposition. The dip coating and spray methods did not reach the minimum amount of AgNPs on the fabric surface and showed high AgNPs agglomeration. The exhaustion method showed the best results for both NPs distribution and reduced agglomeration. The best antibacterial performance was exhaustion at 30 °C, which exhibited less agglomeration and the best antibacterial efficacy against S. aureus (4 log reduction). For E. coli, the antimicrobial effect showed good results in all the exhaustion samples (5 log reduction). Atmospheric plasma is an alternative and cost-competitive method to low-pressure plasma and wet chemical treatments for medical textiles, avoiding the need of expensive vacuum equipment, allowing continuous and uniform processing of fibers surfaces and providing intrinsic sterility of the treated surfaces. New insights in mechanisms of activation, degradation and functionalization of NPs, and polymers will have a huge potential for long-term exploitation of biomedical applications and will contribute to better quality of life and health.

Keywords: Wound dressing, DBD Plasma, Silver, Nanoparticles, Antimicrobial

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