ANTIBACTERIAL TEXTILES BASED ON POLY-PYRROL NANOCOATINGS

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Abstract

The market of antibacterial textiles has gained increasing importance in the last few years. The growth of micro-organisms has negative effects on textiles, such as the generation of odour and stains, which is a particularly important problem in biomedical and technical textiles.

Nowadays, commercially-available antibacterial textiles usually use broad-spectrum biocides such as silver, quaternary ammonium compounds and triclosan as active agents.[1] However, recent studies have shown that silver nanoparticles are able to penetrate into the cells, damaging the genotype. Besides, triclosan is a photo-reactive agent that is able to form chlorinated dioxins, toxic for water-living organisms. Therefore, it is important to develop new materials for antibacterial textiles.

One of the main approaches in the development of alternative antibacterial materials is based in the presence of positively-charged molecules that disrupt the cell wall of the bacteria.[1] Polypyrrole, a widely known semi-conductive polymer, bases its conductivity on the dislocation of positive charges along its conjugated structure. Textile fibers coated with chemically-synthesized polypyrrole have been shown to have antibacterial activity, although most part of it is lost during laundering.[2]

In this work, plasma polymerized polypyrrole-like nanocoatings have been developed on textile yarns through RF plasma enhanced chemical vapour deposition (PE-CVD), which is a solvent-free and environmentally friendly alternative technique. Plasma parameters such as power discharge, monomer flow, pressure, time and presence of gas carrier have been studied in order to obtain the best deposition conditions to get high conductivity and, therefore, the best antibacterial performance. Although the conductivity of the plasma polymerized polypyrrole is not as high as the one of the chemically synthesized polypyrrole, doping with iodine leads it conductive. Adhesion to the fibres has also been studied and improved through the use of argon plasma pre-treatment on the textile samples.

Plasma polymerized polypyrrole coatings have been characterized through conductivity, FT-IR, SEM and XPS measurements. Antibacterial activity against *Escherichia coli*, *Staphylococcus aureus* and *Klebsiella pneumoniae* of coated textiles have been evaluated following the international standard test methods: ASTM E 2149 and EN ISO 20645, dynamic and static methods, respectively. The antibacterial efficiency has been also studied after fastness tests simulating stresses to which the textiles are subjected during processing, maintenance and final use. Fastness has been evaluated following international standard test methods: laundering, dry-washing, abrasion, rubbing and fastness to perspiration.

References

[1] Y. Gao, Textile Research Journal, **78**, (2008), 60-72

[2] A. Varesano, C. Vineis, A. Aluigi, F. Rombaldoni, "Antimicrobial polymers for textile products". In: A. Mendez-Vilas (Ed.), "Science against Microbial Pathogens: Communicating Current Research and Technological Advances, Vol. 3", Formatex, Microbiology Series Nº3, Vol. 1, Badajoz, Spain, pp. 99–110 (2011). ISBN-13: 978-84-939843-1-1.

Figures

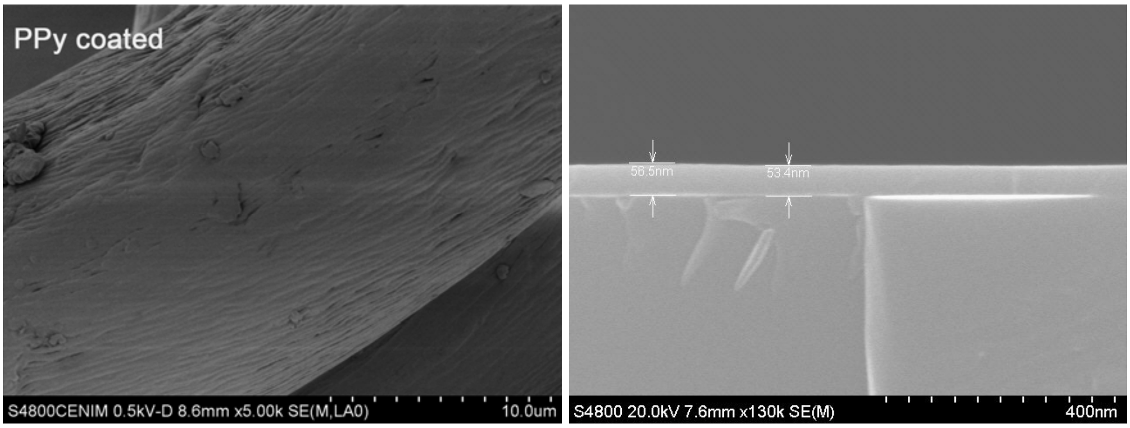

Figure 1. SEM pictures from a poly-pyrrole coating deposited in cotton fabrics.

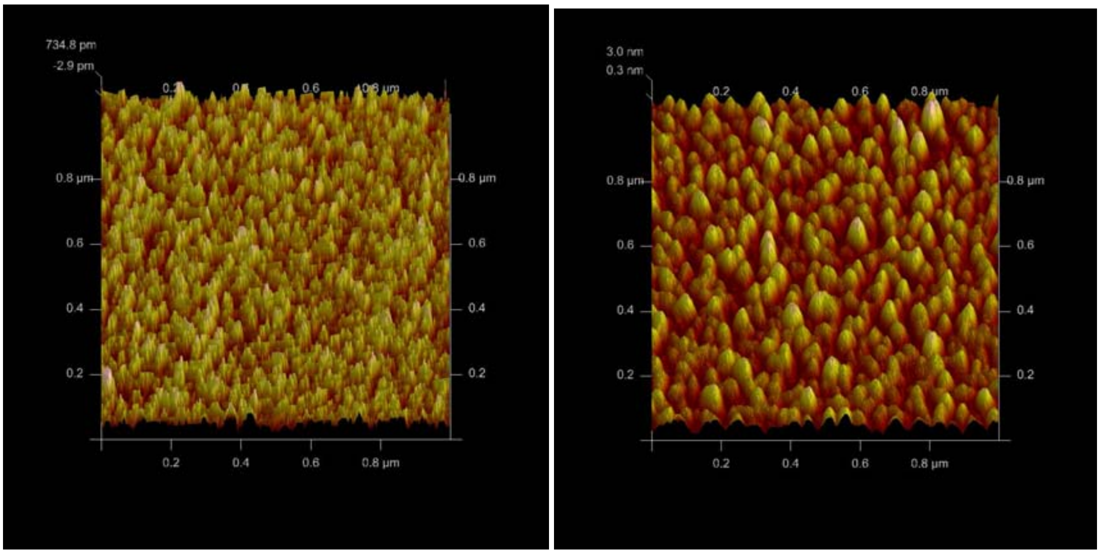

Figure 2. 3D images of AFM mapping carried out in tapping mode of 1.0 µm2 areas of polypyrrole coated substrates. Coating deposited at A) 10W and B) 100W, respectively