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ORIGINAL PAPER

# Antibacterial properties of polyaniline–silver films

[a,b]Zdenka Kucekova, [b,c]Vera Kasparkova, [a,b]Petr Humpolicek*, [c]Petra Sevcikova, [d]Jaroslav Stejskal

[a] *Polymer Centre,* [c] *Department of Fat, Surfactant and Cosmetics Technology, Faculty of Technology, Tomas Bata University in Zlin, T.G.M. Sq. 275, 762 72 Zlin, Czech Republic*

[b] *Centre of Polymer Systems, Polymer Centre, Tomas Bata University in Zlin, T.G.M. Sq. 5555, 760 05 Zlin, Czech Republic*

[d] *Institute of Macromolecular Chemistry, Academy of Sciences of the Czech Republic, Heyrovsky Sq. 2, 162 06 Prague 6, Czech Republic*

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In situ polymerised thin polyaniline (PANI) films produced on polystyrene dishes were tested for their antibacterial activity with respect to *Escherichia coli* and *Staphylococcus aureus*, representing both gram-positive and gram-negative bacteria. PANI films were subsequently used for the reduction of silver ions to metallic Ag. PANI salt and base in original forms and after the deposition of Ag were studied. PANI salt showed a significant antibacterial effect against both bacteria strains while the efficacy of neat PANI base was only marginal. After the Ag deposition, the PANI base exhibited different levels of antibacterial effect depending on the type of the bacterial strain; the growth of gram-positive *Staphylococcus aureus* was inhibited depending on the Ag concentration on the film, while *Escherichia coli* remained uninfluenced. Efficacy of the PANI salt with deposited Ag against both bacteria strains was comparable with that of PANI alone and was not affected by the Ag concentration. The results show that Ag deposition can be a suitable method for the preparation of PANI base films with improved antibacterial properties.


**Keywords:** polyaniline, silver, antibacterial properties, *Escherichia coli*, *Staphylococcus aureus*

## Introduction

Besides all its advantages, application of polymers in medicine brings also a problem related to the occurrence of nosocomial infections. Therefore, a considerable effort has been exerted to develop polymers or composites with efficient antibacterial properties. In addition to polymer materials which possess an intrinsic antibacterial activity, these properties can be also achieved through (*i*) coating or adsorption of an antibacterial agent onto the polymer surface; (*ii*) immobilisation of an antibacterial agent in the polymer via ionic or covalent bonding or (*iii*) by direct incorporation of an antibacterial agent into the polymer during its synthesis (Radheshkumar & Münstedt, 2005; Bílek et al., 2011). Recently published studies indicate that among the polymers inherently showing antibacterial properties are also conducting polymers such as polyaniline (PANI) (Stejskal et al., 2010), which has been the subject of considerable attention due to its potential in biomedical and other promising applications (Pelíšková et al., 2007). Its efficacy against gram-positive and gram-negative bacteria and against fungi was first reported by Seshadri and Bhat (2005) and Shi et al. (2006). Seshadri and Bhat (2005) prepared cotton fabrics coated with an in situ polymerised PANI salt. They observed significant reduction of the colony-forming units (CFU) of gram-positive *Staphylococcus aureus* (*S. aureus*, 95 %), gram-negative *Escherichia coli* (*E. coli*, 85 %) and *Candida albicans* fungi (92 %),

*Corresponding author, e-mail: humpolicek@ft.utb.cz