Silver nanocluster/silica composite coatings obtained by sputtering for antibacterial applications

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Abstract. Silver nanocluster silica composite coatings were deposited by radio frequency co-sputtering technique on several substrates. This versatile method allows tailoring of silver content and antibacterial behaviour of coatings deposited on glasses, ceramics, metals and polymers for several applications. Coating morphology and composition as well as nanocluster size were analyzed by means of UV-Visible absorption, X-ray diffraction (XRD), Field Emission Scanning Electron Microscopy (FESEM), electron dispersive spectroscopy (EDS), X-ray Photoelectron Spectroscopy (XPS) and Atomic Force Microscopy (AFM). The antibacterial effect was verified through the inhibition halo test against standard bacterial strain, *Staphylococcus aureus,* before and after sterilization process. Tape test demonstrated a good adhesion of the coatings to the substrates.

1. Introduction

Materials with antibacterial properties are widely requested in several fields where the risk of microbial contamination is considered a relevant issue, such as biomedical implants, agricultural/food industry, facilities in crowded places (bus, telephones), personnel protective systems and also space structures [1-3].

Silver is the most known and documented antimicrobial agent and its powerful action can be expressed in several forms as metallic, nanoparticles and ions [4, 5]. Silver antibacterial properties can be conferred to glasses, ceramics, metals and polymers by means of several techniques as ions-exchange, sol-gel method and sputtering [6–10]. Sputtering is one of the most versatile coating methods, suitable for most of substrates, because it does not reach high temperatures which could compromise the mechanical and thermal properties of materials to be coated (e.g. polymers) [10].

Preparation and characterization of materials with antibacterial properties are topics well covered by the authors' research group [11–17].

In this paper, antibacterial silver nanocluster silica composite coating were deposited on several substrates, using radio frequency (RF) co-sputtering technique [15–17] and setting several process parameters as a function of the substrate. Silica was chosen as a matrix for the composite coating because it provides good mechanical and thermal resistance, whereas silver nanoclusters confer antibacterial activity. In addition, silver nanoclusters embedded in a silica matrix allows the reduction of silver amount, if compared with pure silver coatings, with advantages in terms of toxicity [18, 19].

A characterization of the composition and morphology of the coating was also reported. The antimicrobial behavior was analyzed through the evaluation of the inhibition halo against