



# Silver nanocluster-silica composite antibacterial coatings for materials to be used in mobile telephones



Marta Miola<sup>a,\*</sup>, Sergio Perero<sup>a</sup>, Sara Ferraris<sup>a</sup>, Alfio Battiato<sup>b</sup>, Chiara Manfredotti<sup>b</sup>, Ettore Vittone<sup>b</sup>, Davide Del Vento<sup>c</sup>, Simona Vada<sup>c</sup>, Giacomo Fucale<sup>d</sup>, Monica Ferraris<sup>a</sup>

<sup>a</sup> Applied Science and Technology Department, Politecnico di Torino, Torino, Italy

<sup>b</sup> Physics Department, NIS excellence centre and CNISM, University of Turin, Torino, Italy

<sup>c</sup> Concept Reply, Turin, Italy

<sup>d</sup> Chemical, Clinical and Microbiological Analyses Dept., CTO Maria Adelaide Hospital, Turin, Italy

## ARTICLE INFO

### Article history:

Received 5 February 2014

Received in revised form 20 May 2014

Accepted 23 May 2014

Available online 2 June 2014

### Keywords:

Coating

Sputtering

Silver nanocluster

Antibacterial

## ABSTRACT

Antibacterial coatings containing different amount of metallic silver nanoclusters embedded in a silica matrix have been deposited by co-sputtering technique on several different polymers used in mobile telephones components such as: screens, covers, and microphone felts.

Sputtering parameters have been varied to obtain different coating thickness and silver content, in order to meet antibacterial, aesthetic and functional requirements for each component. In particular, an antibacterial functionality has been obtained for screens, covers and felts without affecting their respective transparency, aesthetic and acoustic properties.

The optimal parameters for each part have been used to obtain an antibacterial mobile telephone suitable for personnel operating in hospitals or other environments with potentially high bacterial contamination.

© 2014 Elsevier B.V. All rights reserved.

## 1. Introduction

Bacterial contamination is a problem for medical devices but also for a wide number of everyday life objects used by hundreds of people, especially in public places and hospitals. For these reasons, the antibacterial functionality is more and more an important added value.

Various antibacterial coatings have been investigated in the literature [1–11] and some of them are available on the market [12–15]. In particular silver-containing materials are being widely used since silver is known to have a powerful anti-bacterial activity [5,16,17] and to induce low bacterial resistance compared to that of antibiotics. These features are of high importance to fight the worldwide plague of bacterial increased resistance to antibiotics, in particular inside hospitals [18,19].

Several techniques able to provide an antibacterial surface on different materials have been developed [1–11].

The drawback of most techniques is that they do not give thermal and mechanical stable coatings or that they considerably change the appearance of the coated materials.

The process used in the present work allows the synthesis by co-sputtering technique of an antibacterial layer characterized by silver nanoclusters embedded in a silica matrix. The co-sputtering technique is extremely versatile: the thickness and silver (or other metals) content can be tailored to fulfil different antibacterial and aesthetic requirements. These layers combine the chemical, mechanical and thermal stability of silica with the broad spectrum antibacterial activity of silver.

Silver nanoclusters-silica composite antibacterial layers on silica, soda-lime and some polymers have been fully characterized and discussed in [20–25]. They are suitable for most of substrates, in particular for polymers [25], which are mostly used for mobile telephone components.

Mobile telephones are in the top ten of the most used objects by billions of people every day. The mobile telephone is manipulated in different situations (at work, at home, in public spaces, etc.), stored in various places (bags, pockets, desks, cars, etc.) and it is in contact with our body (ear, hand, mouth, hair, etc.) with strong potential to carry high levels of bacteria.

A scientific research [26] systematically studied bacterial contamination of public telephones on the ear and mouth pieces. The

\* Corresponding author. Present address: Present affiliation: Department of Health Sciences, Università del Piemonte Orientale "A. Avogadro", Novara, Italy.  
Tel.: +39 0110904717/+39 3471327373; fax: +39 0110904624.

E-mail address: [marta.miola@polito.it](mailto:marta.miola@polito.it) (M. Miola).