OR2002

MECHANISMS OF SILVER DIFFUSION AND IONIZATION IN ZrCN COATINGS FOR ANTIBACTERIAL ACTIVITY ON MEDICAL DEVICES

Sebastian Calderon[1], R. Escobar Galindo[2], A. Cavaleiro[3], S. Carvalho[1]

[1]Minho University, Guimaraes, Portugal [2]ICMM, Madrid, Spain [3]University of Coimbra, Coimbra, Portugal

secave44@gmail.com

Antibacterial materials have become a relevant topic for materials scientists due to the necessity of controlling the bacterial colonization on medical devices. As a result, several reports have been published showing the efficacy of silver nanoparticles (Ag NPs) as antibacterial material. Nevertheless, studies on the action durability and effectiveness provided by this element in functional materials are still missing for long term applications, such as orthopedic devices which need to attain certain mechanical, chemical and biological characteristics. This work is focused on evaluating the viability of zirconium carbonitrides (ZrCN) as a matrix to incorporate silver nanoparticles and to assess silver ion release kinetic as a function of time, particles sizes and distribution inside the film matrix. ZrCN coatings with Ag NPs were produce by dual unbalance magnetron sputtering using two Zr targets in an Ar, C2H2, N2 atmosphere. Silver pellets were placed on one of the targets in order to achieve the desired composition (11 at.% of Ag). After deposition, samples were annealed up to 500 °C with the purpose of changing the particles size and distribution of silver NPs in the film. Samples, before and after thermal treatment, were evaluated by X-ray diffraction (XRD) to access the evolution of the crystalline structures. Besides the peaks originated by a cubic lattice structure, typical for a B1-NaCl crystal structure, from the ZrCN matrix at room temperature, Ag peaks are also detected after thermal treatment. The silver ion diffusion was estimated by immersing the sample into 10 ml of Hank’s Balance salt solution (HBSS) up to 1 month of immersion. Inductively coupled plasma optical emission spectrometry(ICP-OES) was used to determine the content of silver ions in the electrolyte, as a function of the immersion time and correlated with the Ag NPs size. Compositional depth profiling of the coatings before and after the thermal process were carried out by glow discharge optical emission spectroscopy (GD-OES). Scanning electron microscopy (SEM) was used to assess the silver distribution through the film thickness after thermal annealing.

Keywords
Silver diffusion
Silver ion release GDOES