National Institute of Materials Physics
Atomistilor Str. 105bis, PO Box MG7, Magurele, Bucharest, Romania, 077125,Telephone : +40213690185
Fax: +40213690177, E-mail : secretariat@infim.ro, www.infim.ro

SPITALUL CLINIC DE URGENTA Bucuresti

Antifungal activity against *Candida Albicans* biofilm of composite layers based on silver doped hydroxyapatite-polydimethylsiloxanes

C.S. Ciobanu[1], C. L. Popa[1], S.L. Iconaru[1], S. Gaiaschi[2], P. Chapon[2], A.M. Prodan[3, 4], A. Groza[5], M. Ganciu[5], D. Predoi[1,*]

[1]National Institute of Materials Physics, 405 A Atomistilor Street, P.O. Box MG 07, Magurele 077125, Romania; *Corresponding author: dpredoi@gmail.com
[2]Horiba Jobin Yvon S.A, 16-18, rue du Canal, Longjumeau Cedex 91165, France
[3]Emergency Hospital Floreasca Bucharest, 8 Calea Floresca, 014461 Bucharest, Romania
[4]Carol Davila University of Medicine and Pharmacy, 8 Eroii Sanitari, 050474 Bucharest, Romania
[5]National Institute for Laser, Plasma and Radiation Physics, 409 Atomistilor St. P.O. BOX MG 36, Magurele 077125, Romania;

ABSTRACT

The development of nanotechnology has brought improvements to the field of nanomedicine, providing biomaterials that are able to mimic the human body tissues to a certain point. Nevertheless, in this area, there are still many challenges to overcome. Even though we live in an era of technology advances, the medical field is still struggling to find new and more effective methods for fighting off viruses, bacteria and fungi. Candida species are considered the most dangerous human fungal pathogens responsible for deep tissue and mucosal infections, especially in the oral cavity, being proven that up to 50% of hospital-related with *C. albicans* infections are deadly. In this context, the goal of this research was an *in vitro* evaluation of the effects of various composite layers based on silver doped hydroxyapatite/polydimethylsiloxane (Ag:HAp-PDMS/Ti) or hydroxyapatite/polydimethylsiloxane (HAp-PDMS/Ti), prepared by combining corona discharge at atmospheric pressure and sol-gel dip coating method, on Candida albicans (*C. albicans*) adhesion to layers surfaces. This study was focused on surface and structural characterization of HAp-PDMS/Ti, and Ag:HAp-PDMS/Ti by different techniques: Scanning Electron Microscopy (SEM), Glow Discharge Optical Emission Spectroscopy (GDOES) and Fourier Transform Infrared Spectroscopy (FTIR).

EXPERIMENTAL SECTION

The PDMS layers were deposited on Ti substrates in atmospheric air pressure corona discharges in a point to plane electrode configuration. Under corona charge injection (mainly negative oxygen ions) the liquid precursor of vinyl terminated polydimethylsiloxanes that lies on the anode (Ti substrate), is transformed into a solid polymer layer after two hours. Hydroxyapatite was synthesized by sol-gel method using calcium nitrate tetrahydrate and phosphorus pentoxide as Ca and P precursors. The titanium substrate previously coated with a PDMS layer was immersed into HAp sol. Each coating was dried at 80^{o} C for 30 min and the coating procedure was repeated five times. The same procedure was followed for the Ag:HAp-PDMS/Ti (x_{Ag}=0.3) thin film. The morphology of the obtained thin films were investigated by Scanning Electron Microscopy (SEM) using a FEI Inspect S scanning electron microscope. The elemental depth profile analysis of the Ag:HAp-PDMS/Ti and HAp-PDMS/Ti thin films were performed by Glow Discharge Optical Emission Spectroscopy (Horiba Company,Longjumeau, France). The IR spectra of the Ag:HAp-PDMS/Ti and HAp-PDMS/Ti thin films were acquired using a SP100 IR Perkin Elmer spectrometer (Waltham, MA, USA) equipped with a variable angle specular reflectance accessory. The measurements were carried out for an angle of reflection of 300**.** The antimicrobial activity of the obtained thin films were described elsewere [1].

RESULTS

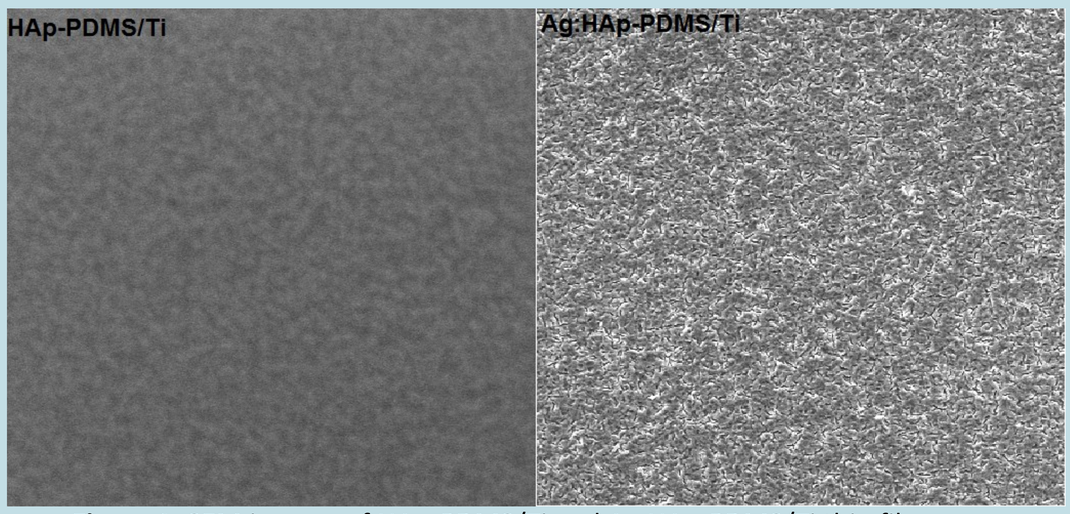

Figure 1: SEM images of HAp-PDMS/Ti and Ag:HAp-PDMS/Ti thin films.

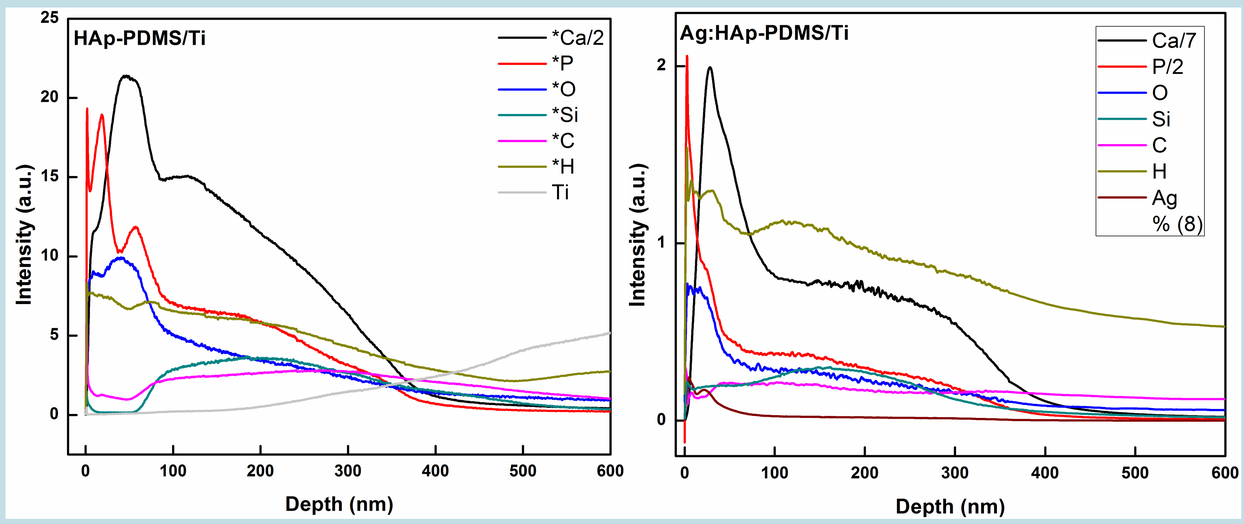

Figure 2: GDOES depth profiles of HAp-PDMS/Ti and Ag:HAp-PDMS/Ti composite layers[2].

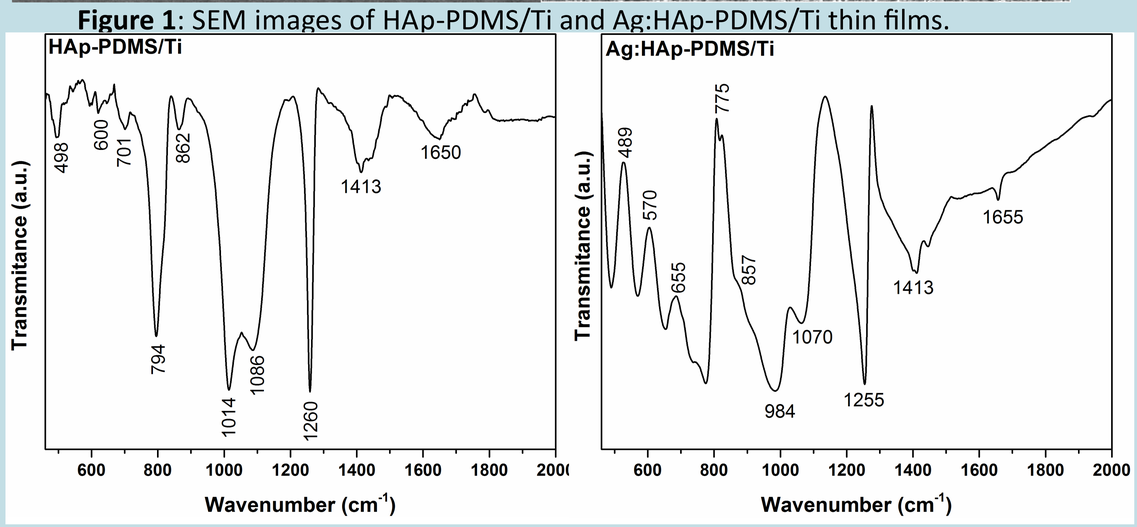

Figure 3: FTIR spectra of HAp-PDMS/Ti and Ag:HAp-PDMS/Ti thin films.

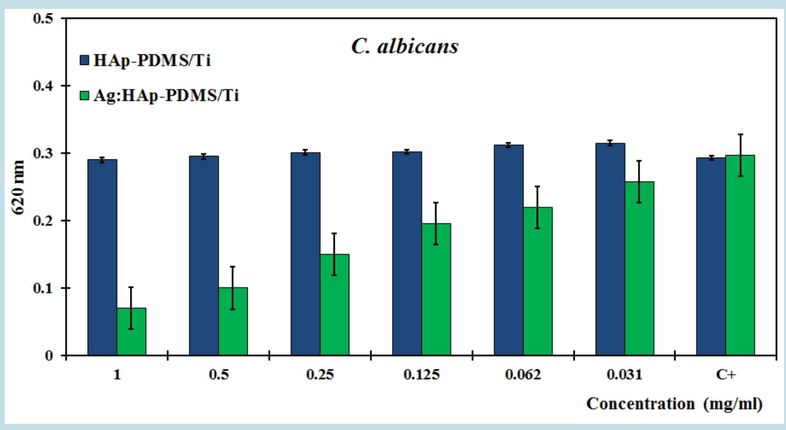

Figure 4: Antifungal properties of HAp-PDMS/Ti and Ag:HAp-PDMS/Ti against *Candida albicans* ATCC 10231.

CONCLUSIONS

The morphological studies revealed that the PDMS polymer interlayer improved the quality of the coatings. The structural investigations revealed the presence of the basic constituents of both apatite and PDMS structure in the thin films. All the functional groups characteristic to apatite and PDMS were found in the IR spectra. The GDOES depth profiles indicated the formation of a composite material as well as the successful embedding of the HAp and Ag:HAp into the polymer. On the other hand, the *in vitro* evaluation of the antifungal properties of Ag:HAp-PDMS/Ti demonstrated its fungicidal effect. The results obtained in this study provide complex insight on the potential mechanism involved in the antifungal activity of silver ions against *C. albicans* biofilms and also emphasize the potential uses of these types of coatings in medical applications.

References: [1].C. S. Ciobanu, et al., BioMed Research International, 2015, Article ID 926513, 13 pages. [2]. A. Groza et al. Polymers 2016, 8, 131;

Acknowledgements: ***These studies were supported by National PN II 259/2014 project.***