FIRST INTERNATIONAL CONFERENCE ON ELECTRON MICROSCOPY OF NANOSTRUCTURES

ELMINA 2018

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• **PO2.19**

Electrochemical Deposition of Ni in the Liquid Cell: Groundwork Experimental Approach Prior to LC TEM Experiments

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• **PO2.20**

Characterization Of Composite Polymer Membranes Modified By Electrospinning Method

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• **PO2.21**

Morphology of Poly(urethane-siloxane)/Montmorillonite Nanocomposites

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• **PO2.22**

Morphology, Biocompatibility and Antimicrobial Activity of Hydroxyapatite Simultaneously Doped with Silver and Strontium Ions

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• **PO2.23**

Nanocomposite Hydrogels Based on Poly(vinyl alcohol) and Chitosan with Silver Nanoparticles and Graphene Aimed for Wound Dressing Applications

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POSTER ABSTRACTS

Nanocomposite Hydrogels Based on Poly(vinyl alcohol) and Chitosan with Silver Nanoparticles and Graphene Aimed for Wound Dressing Applications

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There is a growing need to improve existing biomedical devices for severe wound dressings that would protect the lesion from physical damage and keep the surrounding local tissue moisturized and at the same act as antibacterial barrier for prolonged periods of time. Bacteria, especially in-hospital strains, are quickly developing resistance towards traditional antibiotics; so many studies are directed towards developing wound dressing based on alternative antibacterial agents. Silver nanoparticles (AgNPs) are long known and used for this purpose, owing to their strong antibacterial and antimycotic activity. A problematic aspect of metallic nanoparticle application is their instability and tendency to agglomerate, thereby altering and incapacitating desirable properties of NPs. This problem is often overcome by using polymer stabilizers such as poly(vinyl alcohol) (PVA) and chitosan (CHI), to bind AgNPs and prevent their aggregation, while allowing their release when applied to the wound site.

PVA is a synthetic biocompatible polymer, used for almost half a decade in various branches of biomedicine, among others for wound dressing applications. Chitosan is a natural biocompatible and biodegradable polysaccharide with intrinsic antibacterial properties and polycationic nature – properties which render it desirable biomedical material in applications such as wound dressings and drug delivery. Graphene (Gr) is a relatively recently discovered material with many extraordinary properties, and it has been shown to improve the mechanical properties, such as tensile strength and elasticity, of polymer-based matrices [1], which is especially desirable for topical applications where wound dressing should retain its structural integrity and mechanical strength over longer periods of time, in order to avoid the need for frequent replacement and thus possible trauma to the wound [2].

In this work, we prepared hydrogels based on PVA, CHI and Gr, and used them as a porous matrix to synthesize silver nanoparticles by an *in situ* electrochemical method [3,4]. The hydrogels were prepared from PVA/CHI/Gr colloid dispersions using a simple and effective freezing-thawing method for gelation, without the use of chemical cross linkers. The hydrogels were then swollen in $AgNO_3$ solution to saturate with Ag^+ ions and subsequently subjected to constant-voltage electrical current, to reduce silver ions and to obtain AgNPs. This electrochemical method is fast and green, as there is no need for the use of any (potentially toxic) chemical cross linkers and reducing agents, rendering the final product non-toxic and safe for medical applications.

The obtained silver/poly(vinyl alcohol)/chitosan/graphene (Ag/PVA/CHI/Gr) were characterized by field-emission scanning electron microscopy (FE-SEM) and energy-dispersive X-Ray spectroscopy (EDS), UV-visible and Raman spectroscopies and X-ray photoelectron spectroscopy (XPS). Additionally, the swelling ability and silver release behavior were monitored in phosphate buffer (PB) at 37 °C. The effect of chitosan content on physico-chemical and biological properties of the nanocomposite hydrogels was also investigated. Antibacterial activity was evaluated using disc-diffusion method and test in suspension, against *Staphylococcus aureus* and *Escherichia coli* bacterial strains.

The results indicated the higher concentration of AgNPs in hydrogels with more chitosan, as determined by UV-vis spectroscopy and EDS analysis. Additionally, the antibacterial activity of hydrogels with higher CHI content was stronger towards both *S. aureus* and *E. coli*. FE-SEM (Figure 1) confirmed smaller sizes of AgNPs with the increase of chitosan content in the hydrogel. Silver release studies indicated diffusion-controlled mechanism with initial burst behavior followed by the period of slower and steadier release up to 28 days. All these results confirmed the strong potential for the use of Ag/PVA/CHI/Gr nanocomposite hydrogels in biomedical applications as topical wound dressings with improved properties. [5]

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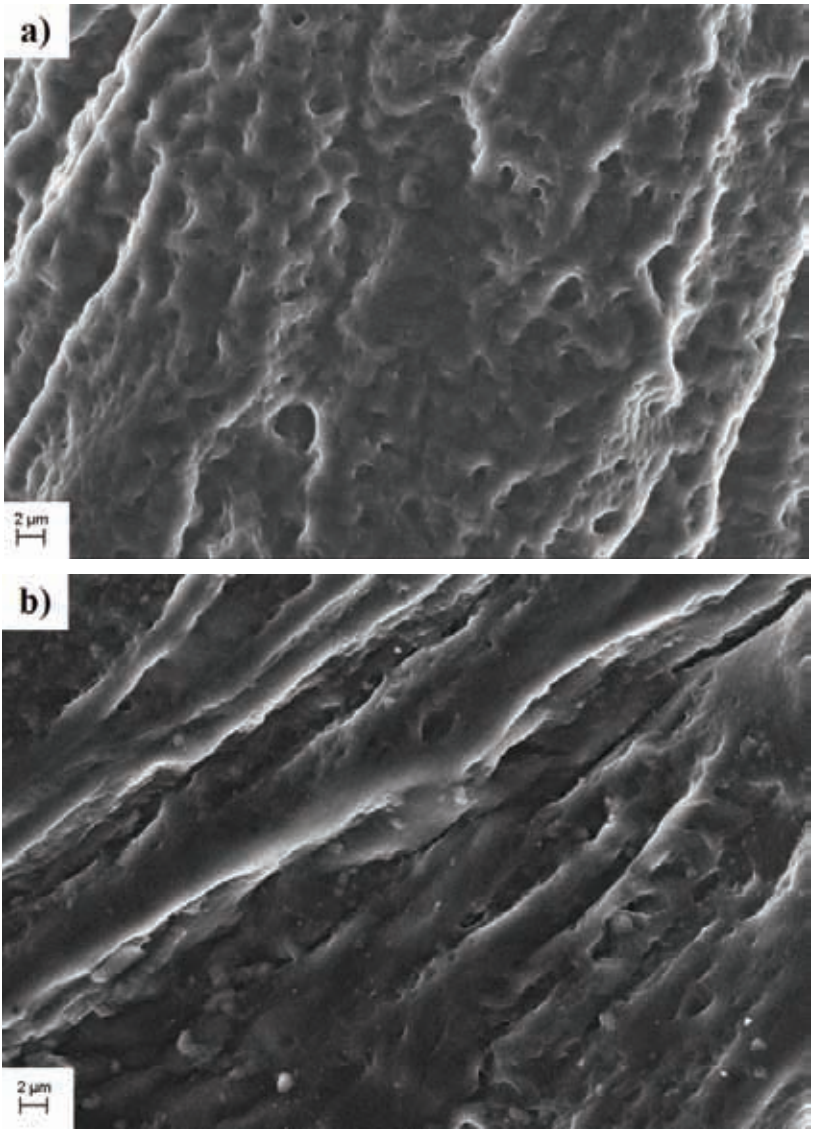

Figure 1. FE-SEM micrographs of a) PVA/CHI/Gr and b) Ag/PVA/CHI/Gr nanocomposite hydrogels

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