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Development of new coatings from marine bioceramics and silver nanoparticles by pulsed laser deposition

Recent works have proposed the reutilization of marine fishing byproducts for the fabrication of ceramics with high biocompatibility [1,2]. Like other biomaterials, these new bioceramics, in addition to their use as bone fillers, can also be applied as coatings, that can be fabricated by different methods, amongst them, pulsed laser deposition [3]. It is well known that such bioceramic coatings are an excellent strategy to improve the biocompatibilty of metal implants and great advances have been achieved in this field during the last decades. However, there is still plenty of room for their improvement. Adding additional biological properties, such as bactericidal effects, increases the interest in the applicability of these materials. In this regard, it is known that silver has inhibitory and bactericidal effects and a broad spectrum of antimicrobial activities [4]. Accordingly, the use of silver (Ag) in the shape of small metallic nanoparticles on top of the bioceramic coatings, seem to be a promising approach. On the other hand, the use of Ag nanoparticles allows us to explore possible applications in the field of biosensors, based on the phenomenon known as plasmon resonance (PR), proper of noble metal nanoparticles.

Thus, this work reports on the growth of a biocompatible ceramic coating obtained from marine fishing byproducts, with silver nanoparticles on top, through a single Pulsed Laser Deposition process.

Metallic disks, simulating the implant material, were successively covered with the bioceramic film and the silver nanoparticles using a pulsed ArF excimer laser (20 ns, 193 nm). Their morphological analysis was carried out by means of Scanning Electron Microscopy (SEM) and Atomic Force Microscopy (AFM); their chemical composition was studied through X-ray Photoelectron Spectroscopy (XPS); and, finally UV-Visible spectroscopy was used for their optical characterization, taking special attention to the plasmonic character of the silver nanoparticles (Figure 1). Hence, we report the fabrication of a new coating from the combination of marine bioceramic and silver nanoparticles as promising alternatives to be used in metallic prostheses, analyzing the influence of the number of laser shots used for the deposition on their physicochemical properties and potential biological effects.

References

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Figures

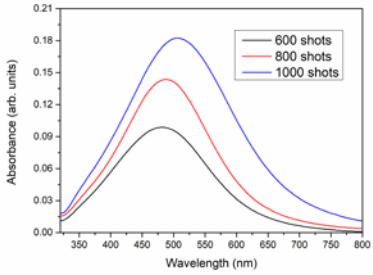

Figure 1: UV-Visible spectra of the Ag nanoparticles deposited by pulsed laser deposition with different number of laser pulses.