FORMATION OF Au NANOPARTICLES IN TIO2 BY ION IMPLANTATION

N. CATARINO, A. RIBEIRO, M. DIAS, M. PERES, E. ALVES
Instituto de Plasmas e Fusão Nuclear, Instituto Superior Técnico, Universidade de Lisboa, Av. Rovisco Pais, 1049-001, Lisboa, Portugal,

J. BORGES, F. VAZ
Centro de Física, Universidade do Minho, Campus de Gualtar, 4710-057 Braga, Portugal Campus de Gualtar, 4710-057 Braga, Portugal

The potential of Gold nanoparticles (NPs) as biosensors is being widely explored in several fields like biology, medicine, chemistry and physics. The applications in chemical and bio- sensing, phototherapy of tumours, nanoscopy and optical imaging are among the most relevant. In this work, we use ion implantation technology to produce Au-nanoparticles in TiO2 dielectric layers in a controlled way. Ion implantation is ideal to control size and depth distribution of the nanoparticles.

Titanium Dioxide films with different thicknesses were deposited by direct current magnetron sputtering method on silicon and glass (for optical studies) substrates. The Au ions with multiple energies were implanted with different fluences to produce a box like profile. The energies used were 50 keV and 150 keV with fluences in the range 1×10^{16} to 2×10^{17} ions/cm^2. After implantation the samples were submitted to annealing in air at 500 ^{o}C for 15 min to induce the precipitation of the Au ions.

The depth profiles were studied with Rutherford Backscattering Spectrometry (RBS) using a $^4He^+$ beam of 1.5 MeV, before and after annealing. The results do not show significant changes on the Au profile at this temperature. XRD analysis show the presence of the (111)Au diffraction peak confirming the formation of Au particles for the films as deposited in Si while for the films on glass the nanoparticles are only observed after annealing. The samples were also analysed using scanning electron microscopy (SEM) to get a better understanding of the size and distribution of the formed NPs. The microstructures were observed in backscattered electron imaging (BSE) and secondary electron imaging (SE) modes using a JEOL JSM-7001F field emission gun scanning electron microscope equipped with an Oxford Instruments X-ray EDS system with an energy of 25 kV. The results show an increase of the density of the particles with the annealing and an average size of 15 nm, Fig. 1.

The optical characteristics of the films was studied using optical absorption spectroscopy in the films deposited in glass. The presence of a band centred at 570 nm, corresponding to the plasmon resonance of Au nanoparticles, was observed.

The possibility to use the technique to develop of platforms to explore optical Transmission Localized Surface Plasmon Resonance (TLSPR)-biosensing systems will be discussed.

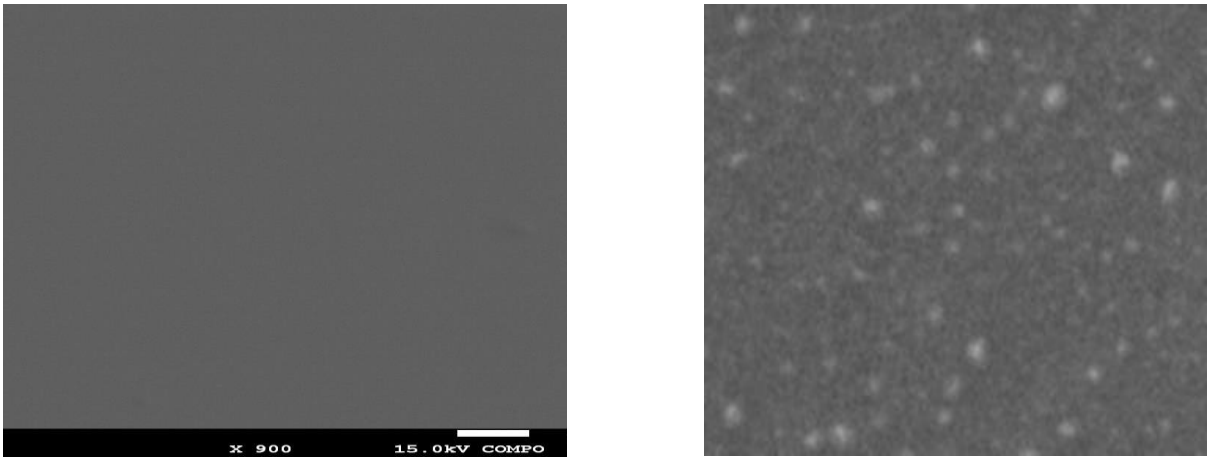

FIG.1. SEM images of a implanted TiO2 film before (left) and after annealing (right) at 500 °C, 15 min.