The electrical, sensory and photocatalytic properties of graphene oxide and polyimide implanted by low and medium energy gold ions

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In our work, we focused on the investigation of the electrical, photocatalytic and sensory properties of graphene oxide (GO) and polyimide (PI) implanted by gold energetic ions. Gold ions (Au^+) are favored for ion implantation into polymers due to several key reasons. Primarily, Au^+ possesses exceptional electrical conductivity, rendering it highly suitable for establishing conductive pathways within the polymer matrix. Additionally, gold exhibits remarkable chemical stability, thereby minimizing undesired reactions with the polymer substrate during the implantation process. The implantation of Au^+ ions is accompanied by crystallization and carbonization of the modified samples, which leads to the disruption of chemical bonds and the formation of network processes [1]. These processes lead to the formation of conjugated systems that promote electric charge transport [2]. Moreover, implanted Au^+ ions exhibit the ability to form new catalytic centers, a key property in the context of photocatalytic processes. At the optimum activation wavelength, the implanted gold ions are activated, which are involved in the organic decomposition reactions [1]. This activation creates catalytic sites that increase the reactivity and efficiency of the process. Thus, the presence of gold ions implanted in the material contributes to the efficient degradation of organic matter and improved photocatalytic activity [3].

The organic non-conductive materials (GO, PI) were subjected to modification using low-energy ions (20 keV) and medium-energy ions (1.5 MeV). The ion implantation was conducted with three different ion fluences. At the lowest ion fluence (3.75×10^{12} cm^{-2}), the formation of carbon islands may occur. The second ion fluence (3.75×10^{14} cm^{-2}) induces the growth of carbon clusters and the formation of conjugated carbon bonds [2]. With the highest ion fluence used (1×10^{16} cm^{-2}), the formation of metal nanoparticles is expected to take place [3].

The elemental composition of the modified films was characterized by Rutherford Backscattering Spectrometry (RBS) and Elastic Recoil Detection Analysis (ERDA). The other analytical methods used were Raman spectroscopy, Fourier Transform Infrared Spectroscopy and X-ray Photo-electron Spectroscopy (XPS). The electrical properties were investigated by two-point method. The photocatalytic properties were tested in a dark chamber by disintegration of rhodamine B using a UV light and then studied by ellipsometry.

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