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Preparation and bio-functionalization of Au:TiO2 nanoplasmonic thin films for LSPR-biosensors

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Thin films composed of noble metal nanoparticles, dispersed in a dielectric matrix, exhibit often some specific optical properties, which is leading to an intensive study of these materials. The Localized Surface Plasmon Resonance (LSPR) is unique for plasmonic materials (e.g. Au and Ag) and the characteristic absorption bands can be tuned by the size, shape and distribution of the metal nanoparticles, as well as by the dielectric medium in which they are dispersed. In recent works, it was demonstrated that a post-deposition heat-treatment is a convenient way to produce ensembles of Au nanoparticles embedded in a TiO2 matrix, with characteristic LSPR absorption bands. The properties of nanoplasmonic thin films are considered promising for applications in sensing technology, namely in LSPR-Sensors, where shits in the plasmon peak are measured when molecules or biological agents are present. Using this approach, the LSPR can be simply characterized from the transmitted light. In this presentation, the possibility of applying nanoplasmonic thin films composed of Au nanoparticles dispersed in TiO2 in LSPR-biosensing will be discussed. In basic terms, this type of sensors compares the Transmittance-LSPR bands in the absence and presence an analyte of macromolecular nature. However, in order to detect specific analytes, the nanoplasmonic films must be previously (bio)functionalized with adhesion layers and biorecognition elements. For this work, different sets of Au:TiO2 films, with variable Au concentration and thickness, were prepared. In order to promote clustering and growth of Au nanoparticles in the matrix, the films were in-air annealed at different temperatures. The surface functionalization was performed by promoting the silanization of (3-mercaptopropyl)trimethoxysilane (MPTS) or (3-aminopropyl) trimethoxysilane (APTMS), after a surface activation with O2 plasma treatment, allowing the bonding of the biorecognition element to the sensing platform.

Keywords
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