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Fabrication and optical properties of TiO_2/Gold nanoparticle composite films: toward plasmonic solar cell applications.

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Abstract

Design of new material architecture has emerged as an interesting aspect of nanotechnology for fabricating advanced functional materials. In fact, to obtain materials with the desired properties, chemical composition is not enough and the geometrical aspect has to be considered. Beyond nanostructuring of material with uniform composition, design of hybrid nanocomposites is an alternative approach to create the synergy between different components which will enhance the existing properties or induce new properties. However, optimization of material properties becomes a balancing act in which several parameters must be taken into account: chemical composition and material structure [1]. Among the more studied hybrid nanocomposites, those based on gold nanoparticles (Au NPs) deposited on TiO_2 film have attracted much attention. This is due to their potential applications in different areas including sensing, photovoltaic and catalysis. Different methods were developed to prepare such a film [2-8].

In this work, we report an approach to design a hybrid nanocomposite film based on Au NPs and TiO_2 particles using centrifugal force. The prepared hybrid nanocomposite films have been characterized by different techniques such as FEGSEM, TEM, BET, DRX and UV-Visible spectroscopy. Our results demonstrate that centrifugal force can enable preparation of hybrid nanocomposite films with controllable porosity. The performed UV-Vis spectroscopy shows a clear decrease of the TiO_2 band gap as a consequence of added Au NPs and the mechanism behind this is discussed. These optical properties make the prepared hybrid nanocomposite film a good candidate for use as a broadband absorption material in photovoltaic applications.

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