Ag:TiO_2 plasmonic nanocomposite films obtained by RF magnetron co-sputtering

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It is known that TiO_2 is a wide-gap semiconductor, which due to its low cost and photocatalytic properties has found great application in purification of water and organic pollution, as well as solar energy [1]. To expand an application area, various methods of functionalization and alloying of TiO_2 with various metallic and nonmetallic impurities and particles are used. One of these ways is usage of plasmon nanoparticles, like Au and Ag, to increase the absorption region in the visible range [2].

In this work, plasmon nanocomposite films of Ag:Ti_{O2} were obtained by RF magnetron co-sputtering [3]. It was revealed that the films consist of an amorphous TiO_2 matrix and isolated silver nanoparticles with 3-5 nm diameter. The optical absorption spectra of Ag:TiO_2 nanocomposite films are characterized by local maxima at 465-480 nm corresponding to light scattering plasmon resonance (LSPR). Photoelectrochemical studies of Ag:TiO_2 nanocomposite films in 0.1 M Na_2SO_4 under illumination with 465 nm light showed that silver nanoparticles presence in the matrix increases the photoconductivity. The quantum yield for Ag:TiO_2 composite films increases significantly, while for a pure TiO_2 film this value does not exceed 0.5%.

In addition, work was carried out related to the degradation of the methylene blue dye (MB dye) under the direct action of solar radiation, from which it follows that the presence of silver nanoparticles in the TiO_2 matrix increases the rate of decoloration of the aqueous solution with MB dye.

Thus, the obtained TiO_2:Ag nanocomposite films are a promising material for use in nonlinear optics, electronics, electrooptics, photocatalytic and antireflection coatings and photoconverters, as well as in biomedicine as antibacterial coatings.

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References

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