UDC 620.3

PLASMON RESONANCE IN NANOSTRUCTURED METAL OXIDE FILMS WITH NOBLE METAL PARTICLES

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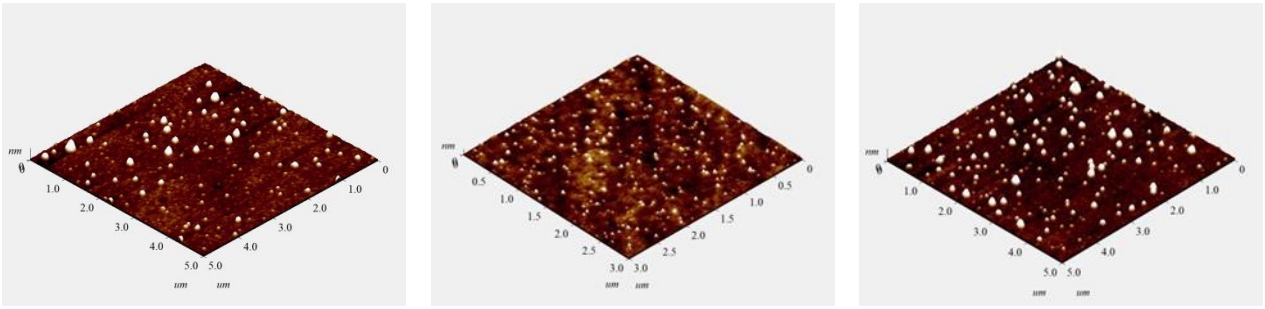
Despite their high cost, noble metal nanoparticles attract significant attention due to their unique plasmonic properties, particularly the localized surface plasmon resonance (LSPR) effect, which depends on the size, shape, and environment of the particles [1-2]. Their interaction with wide-bandgap oxide semiconductors, such as ZnO, enhances photocatalytic properties through charge exchange processes at the metal-semiconductor interface [3]. This study focuses on the controlled shift of the absorption band in composite ZnO:MeNPs (Ag/Au NPs) films, fabricated using magnetron sputtering of a combined target followed by thermal treatment.

Thin ZnO:Ag/Au films were fabricated using RF magnetron sputtering of a combined target, consisting of a 3" ZnO (4N) disc with Ag and Au rods (0.5mm × 10mm) symmetrically placed in the erosion zone. The deposition was performed for 30 minutes at a constant RF power of 70 W and a pressure of 0.7 Pa, maintained by an argon flow of 60 sccm. The target-substrate distance was fixed at 8 cm to ensure film uniformity. Quartz (KU-1) and silicon (n-type, (100), 5 Ω) substrates were used for optical and elemental analysis, respectively. To obtain isolated nanoparticles, the freshly deposited films were annealed in air at 500°C for 20 minutes, with a heating rate of ~12°C/min and natural cooling, optimizing conditions to prevent cracking and minimize nanoparticle size.

Freshly deposited ZnO:MeNPs films were highly transparent, indicating the absence of isolated nanoparticles. Annealing in air induced partial matrix crystallization and nanoparticle formation [4-5], confirmed by AFM analysis.



а) ZnO:AgNPs б) ZnO:AgAuNPs в) ZnO:AuNPs

Fig. 1. – AFM images of the surface of ZnO:MeNPs films after annealing

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