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Development of Au/CuO nanoplasmonic thin films for sensing applications

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Abstract

Nanocomposite thin films, containing Au nanoparticles dispersed in a CuO matrix, were prepared by reactive DC magnetron sputtering and post-deposition thermal annealing. The CuO matrix was found to be stoichiometric and the atomic concentration of Au was determined to be about 12.3 at.%. After the annealing process, the average size of the crystalline domains of the Au nanoparticles (fcc structure) increased from about 6 nm (at an annealing temperature of 300 °C) to approximately 13 nm (after annealing at 800 °C), with a progressive crystallization of the CuO matrix in the monoclinic structure. A nanoplasmonic effect due to the localized surface plasmon resonance (LSPR) phenomenon appeared in the films after annealing temperatures of 400 °C and higher. The correspondent LSPR bands appeared in the visible range of the transmittance spectra, becoming progressively narrower. Angle Resolved X-Ray Photoelectron Spectroscopy results indicated that the surface of Au/CuO nanocomposite thin film is contaminated with a sub-nanometric layer (~0.6 nm) of hydrocarbons and that the Au nanoparticles are relatively homogeneously dispersed inside the CuO dielectric matrix. Furthermore, the results seem also to indicate that the Au nanoparticles are covered with about 0.2 nm of

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