Plasmonic absorption in metal-ZnO nanocomplexes.

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Zinc oxide nanoparticles (ZnO) exhibit semiconductor, photocatalytic, antimicrobial, and piezoelectric properties, while metal nanoparticles (mNP) can exhibit localized surface plasmonic resonance (LSPR) in visible spectral range. Here we study integration of both materials into a hybrid system and how it affects the mNP-ZnO properties for possible practical applications from optoelectronics to photocatalysis or biosensing. We investigate optical absoprtion of aqueous colloidal mixtures composed of ZnO nanoparticles with 20 nm silver (AgNP; LSPR at 394 nm, close to the adsorption edge of ZnO at 370 nm) and gold (AuNPs; LSPR at 524 nm far from the adsorption edge of ZnO), using UV-Vis spectrophotometry and RF electric field simulations. The mixtures show that higher concetration of mNPs (>) gives rise to supressed plasmonic absorption in the presence of ZnO. It is a similar effect as observed and explained for mixtures of mNPs with nanodiamonds [1]. However, spectral shift and across various concentration ratios of mNP and ZnO was not observed. Numerical modeling indicates that ZnO (unlike nanodiamonds [1]) minimally impacts the plasmonic absorption itself, but it enhances the local electromagnetic field of both mNP via dielectric effects.

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[1] V. Hrncirova et al., Diamond Relat. Mater. 154 (2025) 112211.