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PLASMONIC MODE PROPERTIES PROBED ON THE BI-METALLIC STRUCTURE Ag-Au

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ABSTRACT: Optical surface plasmon resonance sensors have been known for a long time. In the Kretschmann configuration, a long interface between a metal and a dielectric, the optical coupling of an incident light to collective oscillation is governed by the metallic thickness. In this work, we discuss the use of a bi-metallic structure to generate surface plasmon-polaritons (SPPs). Firstly, we study the influence of the thickness of silver and gold on the surface plasmon-polariton resonance separately. Secondly, we present the analytical results of the reflected light (versus the incidence angle) for two dispositions Ag-Au and Au-Ag excited with an electromagnetic wave in the visible range (λ=427 nm – 514 nm). In particular, for the metals, we have taken a frequency-dependence in their dielectric permittivities $\varepsilon_{Ag}(\lambda)$ and $\varepsilon_{Au}(\lambda)$ as tabulated in the reference of Johnson and Christhy. Finally, we found the basic characteristics for the resonances of the surface plasmon-polaritons. We underline an important result to produce coupling phenomenon where the surface plasmon resonance becomes independent of the metallic thickness. The plasmonic resonance is just shifted towards total reflection. However, we explain this effect that SPPs on bi-metallic structure can be trapped with an optimal rate in the reflected light. The plasmonic trap obtained by the disposition Au-Ag in contact with a dielectric (ambient air) which is irradiated at a wavelength λ=514 nm, imposes a layer $d_{Au}+d_{Ag}$ = 47 nm. For different values of d_{Au} fixed in the range 20 nm – 46.9 nm, the dip in reflectivity is not related to the thickness d_{Au} beyond the threshold value of 15 nm. An identical characteristic is verified with the wavelength of λ=427 nm where the dip is narrow and the angular resonance is not strongly shifted. When the wavelength is decreased, the control of the plasmonic trap the threshold of d_{Au} is increased.

KEYWORDS: surface plasmon resonance, optical coupling, bi-metallic structure, plasmonic trap

Results

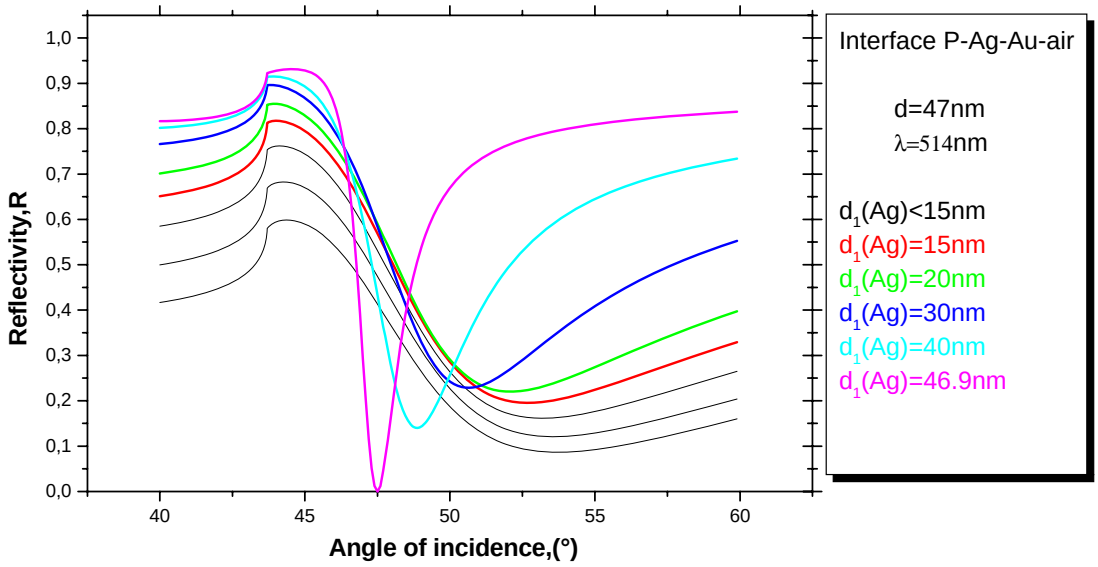

Fig. 1a). : Numerical simulation of the reflectivity curve versus the incidence angle predicted on bi-metallic structure: optical prism-Ag-Au in contact with ambient air. The parameters of the configuration associated to λ =514nm are taken as $\varepsilon_{Ag}(\lambda)$ = -8.45 +i0.82,$\varepsilon_{Au}(\lambda)$ = -3.34 +i 2.78, $d_{Ag}+d_{Au}$= 47nm and ε_p =2.1(permittivity of the prism). The metallic thickness d_{Ag} is indicated in the inset box of the figure.

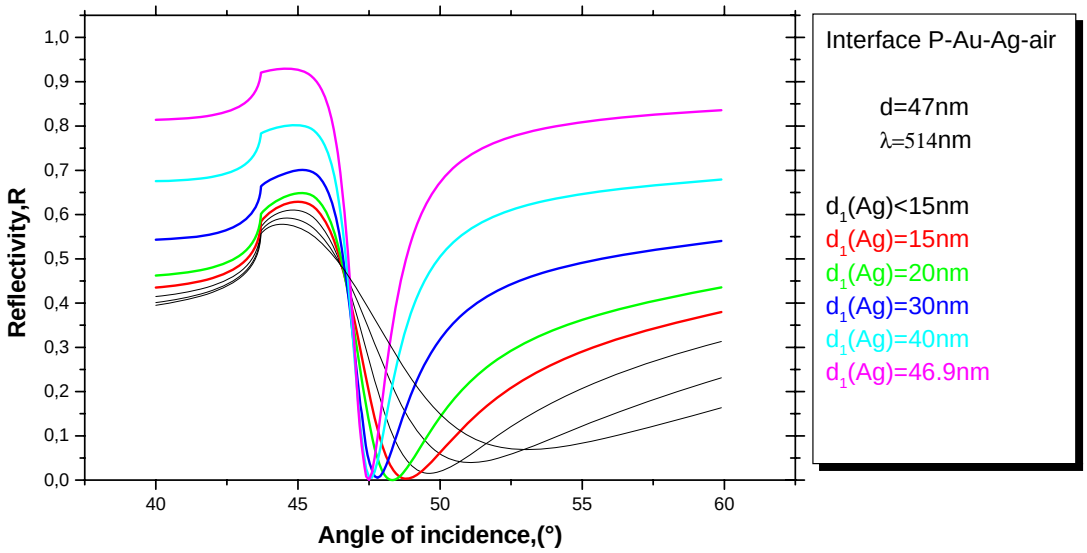

Fig. 1b). : Numerical simulation of the reflectivity curve versus the incidence angle predicted on bi-metallic structure optical prism-Au-Ag in contact with ambient air.

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