Tuning of localized surface plasmon resonance in arrays of gold nanospheres by reorientation of liquid crystals

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Localized surface plasmon resonance (LSPR) in metal nanosphere arrays has gained considerable interest due to potential applications in sensing, photovoltaics, and optoelectronics [1]. In this study, we investigate the tunability of LSPR in closely packed gold nanosphere arrays embedded in a liquid crystal (LC) matrix. The optical properties of the system can be controlled by reorienting the LC, leading to a shift in the plasmon frequency and thus affecting the transmittance and reflectance spectra [2].

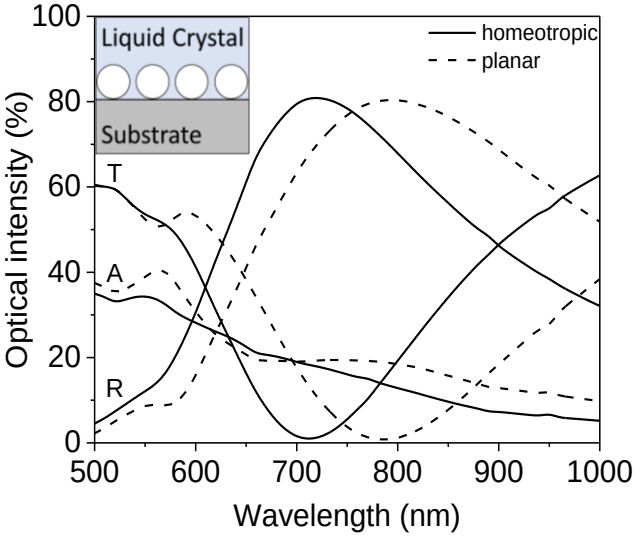

Figure 1. Transmittance (T), reflectance (R), and absorbance (A) for planar and homeotropic LC orientations. Inset: Simplified representation of the structure under consideration.

Numerical simulations were performed in COMSOL to calculate the transmittance, reflectance, and absorbance spectra for a hexagonal monolayer of gold nanospheres, placed on a glass substrate and covered by an LC layer (Fig. 1). Normal incidence of a plane-polarized wave was considered. By manipulating the LC's orientation between planar and homeotropic configurations, we observed a shift in the transmittance dip position by 100 nm, signifying the potential for dynamic tunability in LSPR-based devices. Our results highlight the possibility of using LC reorientation to control LSPR in metal nanosphere arrays, contributing to the development of tunable and reconfigurable plasmonic devices.

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[2] Van Heijst, E. A.; Huurne, S. E.; Sol, J. A.; Castellanos, G. W.; Ramezani, M.; Murai, S.; Debije, M. G.; Gómez Rivas, J. Electric tuning and switching of the resonant response of nanoparticle arrays with liquid crystals. J Appl Phys 131, 083101, 2022.