

Angle-resolved optical properties of the regular arrays of diamond-shaped silver nano-particles

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Surface lattice resonances are plasmonic modes related to the long-range interactions within the regular arrays of plasmonic nano-particles. These resonances result in the sharp features in the optical spectra of plasmonic nano-composite films, while their wavelength can be tuned through lattice constant and the surrounding medium providing a high potential for near-field sensing applications. Such sharp features in optical spectra of systems with regular surface or volume corrugations can also be a signature of mere grating anomalies. In order to distinguish the surface lattice resonances and grating anomalies in optical spectra, it is necessary to analyze the angle-resolved optical spectra both in reflection and transmission. This task is of tremendous computational difficulty especially for arrays of large nano-particles of non-spherical shape in non-homogeneous environment. Meanwhile, the angle-resolved experimental analysis requires cm-scale arrays of nano-particles and is thus prohibited for several fabrication techniques. Finally, it is virtually impossible to (i) compute the optical properties of the arrays accounting for the exact shape of the nano-particles and the presence of the defects; or to (ii) fabricate the cm-scale nano-composite samples perfectly corresponding to the simplest model system from the computational point of view. In this work we suggest a different approach: experimental study of the angle-resolved optical reflection and transmission of quasi-regular arrays of silver nano-particles on the surface with perfectly regular corrugations.

The provided experimental analysis includes the impact of the polarization of incident light and of the lattice constant on the optical properties of quasi-regular arrays of silver diamond-shaped nano-particles half-embedded into silica substrate, as well as the random arrays of supported truncated sphere-shaped silver nano-particles. We report the presence of sharp features related to grating anomalies (Wood anomalies of I type) and surface lattice resonances (Wood anomalies of II type) of a larger width.

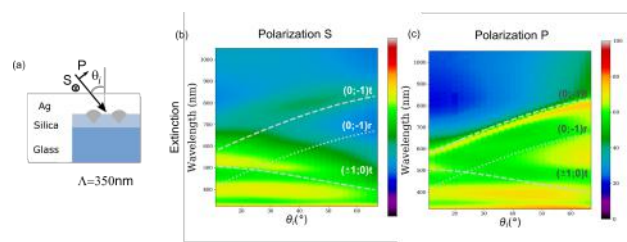


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