

Surface-plasmon Polariton Scattering from a Finite Array of Nanodefects on Metal Surfaces

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We investigate theoretically and numerically the propagation and scattering of surface plasmon-polaritons (SPPs, evanescent waves, bounded to the interface, resulting from a blend of surface plasmons and photons) on surfaces structured with nano-defects. The formulations are based on the reduced Rayleigh equations obtained by imposing either the continuity conditions or the impedance boundary condition, rigorously accounting for all the scattering channels: SPP reflection and transmission, and radiative leakage. The scattering of SPP (both CW and pulsed excitation) in the visible and near IR by single (nano/micro)-defects [1, 2] and finite arrays of nano-defects [3] on an otherwise planar metal interface is studied; both are specially relevant in micro/nano-Optics of SPPs.

In particular, we analyze the range of parameters (defect size and number) for which high SPP reflection efficiency (low radiative losses and negligible SPP transmission) is achieved within a SPP band gap [3, 4], neglecting ohmic losses (justified for array lengths significantly shorter than the SPP inelastic length): Smaller defects play better as SPP mirrors (e.g., efficiency above 90% for Gaussian ridges/grooves with sub-30 nm height and half-width) than larger defects, since the latter yield significant radiative losses [3]. The impact of absorption in real metals on the efficiencies is discussed. Finally, the existence of localized states within the gap (of interest in resonant scattering or filtering) is studied upon introducing vacant sites, anomalous defects, etc.).

REFERENCES

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