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Generalized method of eigenoscillations for near-field optical microscopy BOR-YUAN JIANG, Univ of California - San Diego, LINGFENG ZHANG, Boston University, ANTONIO CASTRO NETO, National University of Singapore, DIMITRI BASOV, MICHAEL FOGLER, Univ of California - San Diego
— Electromagnetic interaction between a sub-wavelength particle (the "probe") and a material surface (the "sample") is studied theoretically. The interaction is shown to be governed by a series of resonances (eigenoscillations), corresponding to surface polariton modes localized near the probe. The resonance parameters depend on the dielectric function and geometry of the probe, as well as the surface reflectivity of the material. Calculation of such resonances is carried out for several axisymmetric particle shapes (spherical, spheroidal, and pear-shaped). For spheroids an efficient numerical method is proposed, capable of handling cases of large or strongly momentum-dependent surface reflectivity. The method is applied to modeling near-field spectroscopy studies of various materials. For highly resonant materials such as aluminum oxide (by itself or covered with graphene) a rich structure of the simulated signal is found, including multi-peak spectra and nonmonotonic approach curves. These features have a strong dependence on physical parameters, e.g., the probe shape. For less resonant materials such as silicon oxide the dependence is weaker, and the spheroid model is generally applicable.

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