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Effect of penetration depth of evanescent wave on scattering by multiple cylinders located near a surface

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Scattering of evanescent wave by particles located on or near a surface is important to near-field applications such as scanning optical microscopy and scanning tunneling microscopy [1,2]. The particles are suspended in an aqueous solution above the surface of an optically denser substrate. They are irradiated by an evanescent wave generated by total internal reflection of a light source in the substrate. The evanescent wave propagates parallel to the interface and decays exponentially with distance from the interface. Particles located within the active range of the evanescent wave interact with the wave to produce scattered radiation. The interaction diminishes as the particles are located farther away. Forward scattering strongly depends on the penetration depth of the evanescent wave, i.e. distance within which its amplitude is finite. This phenomenon suggests that penetration depth can be exploited for characterization of particles located on or near the surface.
A problem of particular interest is the characterization of two-dimensional surface structures using evanescent wave. The surface structure can be simulated by closely spaced parallel infinite cylinders located on the surface. In the present study we shall examine the effect of penetration depth on the intensity and polarization of the scattered wave in the far field. The cylinders are irradiated by an evanescent wave generated by total internal reflection of a source wave in the substrate. The theoretical formulation by Lee [3,4] on scattering of evanescent wave by multiple cylinders will be utilized to formulate the Stokes parameters. The Stokes parameters provide the theoretical basis for assessing the the surface morphology simulated by closely spaced cylinders of different arrangement, size and composition. The effect of penetration depth of the evanescent incident wave on the polarization and intensity of the far field scattered radiation will be examined by numerical analyses.

Reference
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