SURFACE POLARITON MODES

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For a homogeneous isotropic dielectric body of small electrical size, a low frequency approach may be adequate to approximate the scattered field. The leading (Rayleigh) term in the far field expansion is attributable to an induced electric dipole whose moment can be expressed in terms of the electric polarizability tensor, and the tensor elements then serve to specify the scattering and absorption cross sections to the lowest order in the wave number k. If Re $\varepsilon_r > 0$ where ε_r is the relative permittivity of the body, the elements are relatively insensitive to the precise details of of the body's shape, and it may be sufficient to replace the body by a simpler one such as a spheroid (T.B.A. Senior and H. Weil, Appl. Phys B29 (117) 1982), but if Re $\varepsilon_r < 0$ this is not in general true.

Many common materials have molecular resonances in the infrared and optical frequency regions, and some interesting effects are seen when we examine Rayleigh scattering over a frequency band that includes a bulk resonance of the material. In the vicinity of such a resonance, Re $\varepsilon_r < 0$. It is found that the body shape now has a critical effect on the absorption, shifting the frequency at which the absorption line or peak recur, and splitting it into many lines. The resonances are of two distinct types and are generally attributed to volume and surface polariton modes in the body (see, for example, D. Langbein, J. Phys. A9 (627) 1976).

The purpose of this paper is to examine the excitation and properties of surface polariton modes at low frequencies. Using the program DIELCOM (T.B.A. Senior and T. M. Willis, IEEE Trans. AP-30 (1271) 1982) developed to solve the electrostatic problem for a homogeneous, rotationally symmetric body of otherwise arbitrary shape, the excitation is explored by progressive deformation of a spheroid. At a value of Re ε_r (<0) for which a mode is excited, the field inside (and in the immediate vicinity of) the body is determined, and its properties related to the geometry.

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