Abstract

Is There an Effective Medium for the Coherent Reflectance from a System of Random Mie Spheres?

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We calculate the coherence reflection and transmission of electromagnetic waves from a slab with a dilute system of randomly-located polarizable spherical particles. We focus our attention on the case when the size of the spheres is comparable to the wavelength of the incident radiation. First, using scattering-wave and Mie theories, we derive expressions for the coherent fields that are transmitted and reflected by a very thin slab. Then we find the effective current distribution that would act as a source of these fields. We conclude that if the effective currents were induced in an effective medium, this medium must posses, besides an effective electric permittivity, also an effective magnetic permeability. We find that both of these optical coefficients become functions of the angle of incidence and the polarization of the incident wave. With these coefficients we calculate the effective index of refraction and, with Fresnel formulas, the half space reflectance we corroborate that these results are consistent with the wave scattering approach. Numerical results are presented for the optical coefficients as well as for the half-space reflectance as a function of several parameters. The reflectance is compared with that obtained without considering the magnetic response. Finally, we discuss the relevance and the physics behind our results, stressing the issue of the internal consistency of an effective-medium approach to this problem.

[¶]Presenter