Compact group approach to analysis of the dielectric and optical characteristics of finely dispersed systems and liquids

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A new method for studying the long-wavelength dielectric and optical characteristics of particulate systems, such as dielectric composites, suspensions, and liquids, is presented. The method is based upon the concept [1] of macroscopic compact groups of particles, according to which a particulate system is treated as a set of macroscopic regions that have typical scales much smaller than the wavelength of probing radiation, but yet include sufficiently large numbers of particles to reproduce the properties of the entire system. The analysis begins with consideration of the electrodynamic problem on propagation of an electromagnetic wave within such a system. The formal solutions for the electric field and induction are represented in the form of infinite iterative series. With a special representation for the electromagnetic field propagator, the short-range multiple reemission and correlation effects within compact groups are shown to be the primary factors responsible for the formation of the above characteristics of the system. Their averaged contributions can be singled out from all terms in the iterative series and then effectively summed up. Depending on the problem to be solved, either averaging over volumes much greater than the scales of compact groups or statistical averaging involving many-particle correlation functions can be applied.

The efficiency of the method is demonstrated by using it to calculate the effective dielectric constant of systems of hard dielectric particles, which are in general inhomogeneous and anisotropic in both shape and dielectric properties, and to incorporate short-range multiple scattering effects into the theory of light scattering by systems of hard spherical particles. The results obtained are discussed.

1. M. Ya. Sushko, *Zh. Eksp. Teor. Fiz.* **132**, 478–484 (2007) [*JETP* **105**, 426–431 (2007)].