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Lattices of Dielectric Resonators

Springer

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Preface

It is well known that the analytical scattering theory of electromagnetic waves on different bodies consists of three non-equal-sized parts, namely: the Rayleigh theory, based on the assumption of the smallness of the scatter sizes relative to the wavelength; the optics itself with an assumption of the scatter dimensions exceeding relative to the wavelength; the physical theory of diffraction, with the idea of locality of the scattering on different segments of the body.

In the physical theory of diffraction the scattering body is usually presented in the form of assembly of separated fragments, with priori known scattered fields, as a result of different key problem solutions. Under the key problems of the limited set of scattering tasks, accurate analytical solutions in sufficiently simple form have been considered.

An individual class dealing with the scattering problem on resonant bodies, specifically on multilinked dielectric structures, called coupled Dielectric Resonator (DR) systems, has been established. The main difficulty of such structures is that the incident scattering waves have a variety of reflections inside resonators eliminating the possibility of real ray tracing provision.

The scattering theory development along with attraction of the physical theory of diffraction is also a complicated task. Nevertheless, the scattering theory on dielectric bodies became feasible due to assumption of the nonlocal nature of the electromagnetic field. In the case of wave scattering on resonant structures their properties can be defined by not so many individual sections, but rather by the whole structure itself. In contrast to cases of non-resonant scattering, the conception that multilinked resonance scatters act as nonlocal structures appears to be productive and allows to build consistent closed theory, which provides a good accuracy of the main physical parameters calculation. The development of this theory is the main concern in the current study.

At the initial stage of the research it was not clear in what way the physical assumptions would influence the accuracy of carried calculations. Appearance of various software with numerical solutions to the Maxwell's equations allowed to conduct the great variety of simulations, performed with good accuracy. By

collection and generalization, the pieces of knowledge of different kinds of wave scattering problems on a system of coupled DRs as well as the compound dielectric structures' behavior have been summarized in this monograph.

The main intention of writing this book is to show that the DR theory naturally inscribes into well-known physical scattering conceptions and is also a natural part of both the electrodynamics and quantum mechanics.

The proposed monograph is a sequel to the author's works reflected earlier in Ref. [6] in Chap. 2. Meanwhile, the author does not have the goal to introduce all results published in the scientific literature on the current problem, rather the suggested monograph reflects the personal experience and results obtained during the past 10 years.

The author would like to express his sincere appreciation to Prof. E.I. Nefedov for his friendly support to our not simple time. I also want to express my sincere thanks to my friends V.A. Syzranov and A.M. Alesin and to my postgraduate student T.V. Podgurskaya, without whose practical help this monograph could hardly see the light of day.

Kiev Alexander Trubin

Contents