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## On the origin of the terahertz electromagnetic wave interaction with vacuum-dielectric interface

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The dispute between scientists in Optics about the physical origin of the electromagnetic wave reflected from the boundaries of dielectric media at the microscopic level is more than a century old. Originally, this task was considered for a linear case but lately the dispute has been transferred to non-linear optics and then THz photonics. If we use the Maxwell equations and borderline conditions at the interface between vacuum and dielectric of the Landau-Lifshits type, the reflection coefficient, i.e. the Frenel coefficient will not depend on the sample thickness, which means that it is the same for the semi-infinite sample and the sample of the finite thickness (if we ignore re-reflections of radiation inside the sample). It seems incorrect because in this case the mono-layer of atoms reflects the electromagnetic wave as a 3D sample. The reason for this phenomenon is clear, as the macroscopic Maxwell equations are used for the description of this phenomenon, and for them the matter is infinite. In other words, the values are integrated by the length which is much bigger than the interatomic space.

We describe new approaches for the determination of complex dielectric permittivity of thin films with the thickness of much less than THz radiation wavelength. This method is based in the simultaneous measurement of shapes of THz waves reflected by the sample which has passed through them. We present the analytical and numeric solutions of the Maxwell equation, which allow with ease and precision to establish complex material parameters of films for the cases of transverse electric (TE) and transverse magnetic (TM) polarizations and arbitrary incidence angle of a THz beam. The description of the obtained results is carried out first of all in the dipole approximation, but also with the possibility of extending formalism, considering space dispersion of metamaterials' surface structures.



**Short Bio:**

**Alexander Shkurinov** Alexander Shkurinov in 1985 graduated with honours from the M.V. Lomonosov Moscow State University (MSU), Moscow, Russia. He received his Ph.D. degree in Physics from MSU in 1988. Since 2004 he is a full-time

Professor at the Department of Physics of the MSU where he is Head of the Laboratory of terahertz optoelectronics. The research interests of Alexander Shkurinov are mainly centered around the development and application of femtosecond laser techniques, time-resolved spectroscopy of molecules in liquid phase, nonlinear optics and THz techniques and spectroscopy. The results obtained by Alexander Shkurinov have been published in more than 350 scientific papers in peer-reviewed journals.