APPLICATIONS OF TERAHertz RADIATION IN DIAGNOSTICS: BIOLOGY AND NANOTECHNOLOGY

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Terahertz time-domain spectroscopy (THz-TDS) [1] has revealed the extraordinary sensitivity to crystalline order [2], temperature of the sample [3] and the conformational form of the molecule [4]. In molecular crystals the assignment is complicated, for instance, by the presence of both internal and external modes (vibrations within molecules and intermolecular ones). There have been numerous attempts to distinguish the signature of external and internal modes in the THz spectra of various molecular crystals by comparing the spectra of samples with similar crystalline structures, by analyzing temperature dynamics of the spectra or by comparing the experimental data with simulations of an isolated molecule.

In the present lecture we aim at studies of the influence of changes of intermolecular bonding in molecular crystals on those of vibrational spectra by means of THz-TDS and Raman spectroscopy on the example of several biological molecular systems. The studied molecular crystals are related to the weakly associated solid-state systems where most intermolecular interactions are dominated by Van der Waals and hydrogen forces. Modeling of these systems with the DFT calculations using standard quantum chemical packages (e.g. Gaussian 03) in general allows one to identify internal vibrational modes of isolates molecules that in some types of molecular crystals permits quality interpretation of low frequency spectra.

We present the review of the recent results on the interaction of terahertz radiation with the complex biological molecular systems and nanostructures. The influence of the radiation on the fictional activity of enzymes is also discussed. A sufficient part of the lecture will be directed to the discussion of the prospect of the THz diagnostics of biopolymers.

We also discuss the study the dielectric properties of nanodispersed materials, such as nanostructured aluminum oxyhydroxides (NOA) and their modification by surface silica (NOAM) in terahertz (THz) frequency range. We discuss the structural sensitive spectra if we change of the material’s annealing temperatures and their chemical composition.