Thin films at terahertz frequencies: physics and applications

B.P. Gorshunov [1], * M.V. Talanov [1], Yu.A. Aleshchenko [2], A.E. Parafin [3], V.P. Koshelets [4], V.S. Stolyarov [1]

[1] Moscow institute of physics and technology, Dolgoprudny, Russia

[2] P.N. Lebedev Physical Institute, RAS, Moscow, Russia

[3] Institute for Physics of Microstructures, RAS, Nizhny Novgorod, Russia

[4] Kotelnikov Institute of Radio Engineering and Electronics, RAS, Moscow, Russia

*email: bpgorshunov@gmail.com

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It is widely accepted that thin films prepared from various materials (insulators, semiconductors, conductors, superconductors), as well as various types of structures based on them, form the basis for modern and future applications in microelectronics and other areas of the national economy (e.g., [1]). A key role in the development of new micro- and nano-electronic equipment belongs to experimental studies of the characteristics of films and structures. They are determined by the fundamental properties of the materials used, and also depend on synthesis methods and deposition procedures of thin functional layers, which provide additional opportunities for controlling these characteristics. Among the most efficient tools in this regard, it is necessary to highlight optical (in the broad sense) spectroscopy, which ensures the determination of the most important fundamental and macroscopic electrodynamic properties of films and film structures in a contactless (in most cases) manner. In addition, optical spectroscopy allows the determination of relevant characteristics of the objects at sub-terahertz and terahertz frequencies, which are promising in the development of modern and advanced telecommunication systems (e.g., [2]). This presentation will review the latest results of our terahertz spectroscopic investigations into the fundamental physical properties of ferroelectric and superconducting (conventional and high-temperature) thin films, the materials that are considered to be among the most promising for designing electronic devices with exceptional characteristics. We will also present a few examples showing how spectroscopic data can be used efficiently to enhance the performance of devices operating at terahertz frequencies.

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