**Optical-pump terahertz-probe diagnostics of the ultrafast carrier dynamics in photoconductive materials**

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Optical pump - terahertz (THz) probe (OPTP) spectroscopy are currently used to obtain information about the ultrafast dynamics of photoexcited carriers in semiconductors. In an OPTP experiments, an ultrafast laser pulse create free charge carriers and a broadband THz pulses (most often in range 0.3-3 THz which corresponds to the photon energies from 1.2 meV to 12.4 meV) are used to probe of sample tramsmission. Unlike the usual optical pump-optical probe experiments, the OPTP technique allows measure the time dependence of the electrical field of probe pulse. Using Fourier analysis, the full complex absorption spectrum can be obtained, which describes amplitude change and a phase shift.

In this work, we utilized the OPTP spectroscopy to measurehe carrier dynamics and charge transport in plasma-treated carbon nanotubes (CNTs) [1]. Impact of defects on the carrier dynamics and charge transport in carbon nanotubes remains undiscovered. In our study we established correlation between controlable number of defects and optoelectronic properties of CNTs. We used the OPTP spectroscopy to measure the carrier lifetimes governed by the trapping time at defect states and found out short and long lifetimes related to the defects. We carried out electron microscopy measurements in addition to absorption, Raman, Fourier-transform infrared spectroscopy (FTIR), THz and OPTP spectroscopy. The complementary nature of these methods allows us to evaluate the contributions of defects in photoconductivity of CNT networks. We find that the introduction of defects added by plasma-treatment leads to increased charge scattering along plasma-created segments and reduced consequently carrier mobility, photoconductivity, and lifetime.

[1] Tatiana N. Kurtukova, Daria S. Kopylova, Nikita I. Raginov, Eldar M. Khabushev, Ilya V. Novikov, Svetlana I. Serebrennikova, Dmitry V. Krasnikov, and Albert G. Nasibulin, Plasma-treated carbon nanotubes for fast infrared bolometers,Appl. Phys. Lett. 122, 093501 (2023)