THZ PHOTOCONDUCTIVE ANTENNAS KIT FOR 780 NM FEMTOSECOND LASER INPUT

D.A. Popov, P.S. Demchenko, G.I. Kropotov, M. K. Khodzitsky
TYDEX, LLC Domostroitelnaya 16, 194292 St. Petersburg, RUSSIA

Photoconductive antennas (PCA) are widely used to generate and detect both pulsed [1] or quasi-pulse [2] broadband and continuous wave [3] radiation in the terahertz (THz) range. These devices form the basis of many terahertz imaging [4] and spectroscopy [5] systems that have shown promising applications in various industries and research areas.

Antennas PCA-SL-50-50-780 and PCA-D-50-7.2-780 manufactured by TYDEX, LLC form an ideal pair of antennas (emitter-detector), on the basis of which it is possible to build a broadband terahertz spectrometer working in the frequency range of 0.1-2.5 THz. We have developed a design of universal adjustment block for implementation in almost any THz devices with optical pumping from free space. The PCA kit design is based on the optical cage system and can be easily modified for both collimated and focused THz beam measurements.

THz photoconductive antennas kit has the following characteristics:

- optical pumping by a femtosecond laser with the wavelength of 780 nm, a pulse duration of 120 fs, a typical power of 10 mW (maximum power of 30 mW);
- unipolar bias voltage is up to 70 V;
- modulation frequency is up to 90 kHz;
- dynamic range at a frequency of 0.3 THz is up to 65 dB;
- frequency range is 0.1-2.5 THz.

[1] P.R. Smith, D.H. Auston, M.C. Nuss, Subpicosecond photoconducting dipole antennas, IEEE Journal of Quantum Electronics Vol. 24, № 2, 1988.
[2] O. Morikawa, M. Tonouchi, M. Hangyo, A cross-correlation spectroscopy in subterahertz region using an incoherent light source. Appl. Phys. Lett. Vol. 76, № 1519, 2000.
[3] E. R. Brown, F. W. Smith, K. A. McIntosh, Coherent millimeter-wave generation by heterodyne conversion in low-temperature-grown GaAs photoconductors, Journal of Applied Physics, Vol. 73, № 1480, 1993.
[4] B. B. Hu, and M. C. Nuss, Imaging with terahertz waves, Opt. Lett., Vol. 20, № 16, pp. 1716–1718, 1995.
[5] X.-C. Zhang and J. Xu, Introduction to THz Wave Photonics (Springer Science, N.Y., 2010), pp. 49–235.

STANDARD-FREE MEASUREMENT OF QUANTUM EFFICIENCY IN THE CASE OF AN ANALOG DETECTOR

D.A. Safronenkov, P.A. Prudkovskii, G.Kh. Kitaeva
Lomonosov Moscow State University, Moscow, 119991, Russia
safronenkov.da14@physics.msu.ru

The standard-free absolute method was proposed in 1980 by D.N. Klyshko for calibration of quantum efficiencies of single-photon photodetectors. The method is based on measuring fluxes of quantum-correlated pairs of photons ("biphotons") generated by spontaneous parametric down-conversion (SPDC) and does not require the use of any pre-calibrated detectors or sources [1]. Now it is widely used in the modern quantum optical technologies, but so far is not adapted for analog detectors that generate single-photon photocurrent pulses with strongly different amplitudes and thus cannot operate in the photon counting mode. Among such devices, for example, are the majority of incoherent far infrared and terahertz wave detectors. The goal of this work was to create a modified Klyshko method for calibrating the quantum efficiency of such non-counting analog-type detectors. In order to find out how to calibrate detectors in the terahertz range, first we started our work with optical analog detectors [2]. This is explained by the fact that the known to be accurately calibrated photon-counting detectors, which are necessary for application and verification of results of our new approach, are easily accessible in the optical range only.

At this step we have explored the possibility of calibrating the cathode quantum efficiency of an analog photomultiplier tube (PMT). The pump source in the SPDC set-up was a single-mode diode laser with a wavelength of 405 nm. A bismuth triborate (BiBO) crystal was used as a nonlinear medium The SPDC *ooe*-type process proceeded in a degenerate mode. After a proper preprocessing, the set of experimental data consisted of charge distribution histograms detected in signal and idler SPDC channels. By special modeling of the histograms, the average number of photoelectrons, emitted by PMT cathode during the detection time, was obtained. By measuring the biphoton correlation function, the mean number of incident photons was determined. This made it possible to estimate the quantum efficiency of the PMT cathode (Fig.1).