Section:

Terahertz Optics and Biophotonics V

Title

Artificially-strained photoconductive heterostructure for efficient THz-waves detection

Authors

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Abstract

Currently, various approaches to the use of THz radiation for medical diagnostics and tissue imaging are being actively developed [1,2,3]. When using a time-domain spectrometer (TDS), the generation and detection of THz radiation occurs coherently, providing a promising approach to solving the problems of medical diagnostics. Modern TDS systems are mainly built on the basis of photoconductive antennas (PCA), which are both sources and receivers (PCA-detectors) of THz radiation. Narrow-bandgap InGaAs photoconductive layer can be used with an optical excitation wavelength of up to 1.6 μm, which is convenient for coupling with compact fiber-lasers. However, pure InGaAs is not suitable for PCA-detectors due to its low ohmic resistance (high Johnson-Nyquist noise) and relatively high lifetimes of charge carriers. A good approach is to use a InGaAs in the form of superlattice heterostructures (SL) InGaAs/InAlAs [4].

We report on a THz PCA-detector based on artificially strained undoped SL (SID) vs a PCA-detector based on a lattice-matched SL (LMD). Using our laboratory TDS with a 780 nm-wavelength laser, we demonstrate the detection advancement of the SID when operating with an optical probe power > 6 mW over the LMD. THz signals, noise characteristics, and signal-to-noise ratios (SNR) for SIM and LMD were compared at different optical probing powers. The noise floor for SID slowly changes with probe power while the noise floor for LMD demonstrates a rapid increase. Both detectors are featured by a bandwidth of 3.5 THz and a SNR up to 70 dB. We believe that SID coupled to a fiber telecommunication wavelength laser could open pave a way toward the production of portable and cost-effective THz spectroscopy and imaging systems.

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