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Title:Carbon nanotube-based photoconductive switches for THz detection: an assessment of capabilities and limitations
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Abstract:Carbon nanotubes possess appealing properties for terahertz (THz) applications. This work investigates the contribution of these properties in the context of THz photoconductive (PC) switches as THz detectors. The analysis engages the received THz electric field, the optical excitation, and the photocarrier dynamics of the carbon nanotube material through Drude-Smith theory and equivalent circuit model. Through this analysis, the effect of each parameter in the detected current can be investigated. Based on a realistic numerical assessment and comparison with our measurements for a conventional LT-GaAs PC switch, it is found that improvement in detected current is theoretically achievable, depending on the relative value of the imaginary photoconductivity of the CNT film. This is a parameter that can be varied through chemical treatment of the film. We found that, unlike the case of PC switches as THz emitting devices where a higher mobility is desired for higher output THz power, the detected current in the THz receiving PC switch is a nonmonotonic function of the mobility in the single-wall carbon nanotubes (SWNT) film. The capabilities and limitations revealed in this study set guidelines for fabrication and optimization of more efficient carbon nanotube-based THz receiving PC switches. The study also addresses the fabrication process and challenges.
Number of references:50
Inspec controlled terms:carbon nanotubes - equivalent circuits - microwave photonics - nanophotonics - nanotube devices - numerical analysis - optical fabrication - optical films - optical switches - photoconducting switches - photoconductivity - terahertz wave detectors - thin film devices
Uncontrolled terms:photoconductive switches - THz detection - terahertz applications - terahertz detection - THz electric field - optical excitation - photocarrier dynamics - Drude-Smith theory - equivalent circuit model - current detection - numerical assessment - imaginary photoconductivity - CNT film - chemical treatment - THz emitting devices - higher output THz

power - nonmonotonic function - single-wall carbon nanotubes - SWNT film - carbon nanotube-based THz receiving PC switches - C

Inspec classification codes:A4280M Optical switches - A4285D Optical fabrication, surface grinding - A4284 - B4185 Optical switches - B4250 Photoelectric devices - B4146 - B1350P Microwave photonics - B2230F Fullerene, nanotube and related devices

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