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Title:Room-temperature terahertz detectors based on semiconductor nanowire field-effect transistors
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Abstract:The growth of semiconductor nanowires (NWs) has recently opened new paths to silicon integration of device families such as light-emitting diodes, high-efficiency photovoltaics, or high-responsivity photodetectors. It is also offering a wealth of new approaches for the development of a future generation of nanoelectronic devices. Here we demonstrate that semiconductor nanowires can also be used as building blocks for the realization of high-sensitivity terahertz detectors based on a 1D field-effect transistor configuration. In order to take advantage of the low effective mass and high mobilities achievable in III-V compounds, we have used InAs nanowires, grown by vapor-phase epitaxy, and properly doped with selenium to control the charge density and to optimize source-drain and contact resistance. The detection mechanism exploits the nonlinearity of the transfer characteristics: the terahertz radiation field is fed at the gate-source electrodes with wide band antennas, and the rectified signal is then read at the output in the form of a DC drain voltage. Significant responsivity values (>1 V/W) at 0.3 THz have been obtained with noise equivalent powers (NEP) < 2 ×10⁻⁹ W/(Hz)^{1/2} at room temperature. The large existing margins for technology improvements, the scalability to higher frequencies, and the possibility of realizing multipixel arrays, make these devices highly competitive as a future solution for terahertz detection. © 2011 American Chemical Society.
Number of references:30
Main heading:Field effect transistors
Controlled terms:Detectors - Indium arsenide - Light emitting diodes - Nanoelectronics -

Nanophotonics - Nanowires - Photovoltaic effects - Selenium - Selenium compounds - Semiconducting selenium compounds - Semiconducting silicon - Semiconductor diodes - Semiconductor growth - Silicon detectors - Terahertz wave detectors - Terahertz waves - Transistors

Uncontrolled terms:Building blockes - Detection mechanism - Drain voltage - Effective mass - Future generations - High mobility - High-sensitivity - Higher frequencies - III-V compounds - InAs - Multi-pixel arrays - Nanoelectronic devices - nanophotonic devices - Non-Linearity - Photovoltaics - Responsivity - Room temperature - Semiconductor nanowire - Silicon integration - Source-drain - Technology improvement - Tera Hertz - Terahertz detection - Terahertz detectors - Terahertz radiation - Transfer characteristics - Wideband antenna

Classification code:944.7 Radiation Measuring Instruments - 933 Solid State Physics - 914 Safety Engineering - 761 Nanotechnology - 741.1 Light/Optics - 732.2 Control Instrumentation - 715 Electronic Equipment, General Purpose and Industrial - 714.2 Semiconductor Devices and Integrated Circuits - 712.1.2 Compound Semiconducting Materials - 712.1.1 Single Element Semiconducting Materials - 711 Electromagnetic Waves

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