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Title:Subpicosecond electron-hole recombination time and terahertz-bandwidth photoresponse in freestanding GaAs epitaxial mesoscopic structures
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Abstract:We present the ultrafast (THz-bandwidth) photoresponse from GaAs single-crystal mesoscopic structures, such as freestanding whiskers and platelets fabricated by the top-down technique, transferred onto a substrate of choice, and incorporated into a coplanar strip line. We recorded electrical transients as short as ∼600 fs from an individual whisker photodetector. Analysis of the frequency spectrum of the photoresponse electrical signal showed that, intrinsically, our device was characterized by an ∼150-fs carrier lifetime and an overall 320-fs response. The corresponding 3-dB frequency bandwidth was 1.3 THz-the highest bandwidth ever reported for a GaAs-based photodetector. Simultaneously, as high-quality, epitaxially grown crystals, our GaAs structures exhibited mobility values as high as ∼7300 cm sup2/sup/V&middots, extremely low dark currents, and ∼7 intrinsic detection efficiency, which, together with their experimentally measured photoresponse repetition time of ∼1 ps, makes them uniquely suitable for terahertz-frequency optoelectronic applications, ranging from ultrafast photon detectors and counters to THz-bandwidth optical-to-electrical transducers and photomixers. © 2012 American Institute of Physics.
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Controlled terms:Epitaxial growth - Gallium arsenide - Photodetectors - Power quality - Semiconducting gallium - Superconducting materials
Uncontrolled terms:Coplanar strip line - Detection efficiency - Electrical signal - Electrical transients - Electron-hole recombination - Epitaxially grown - Frequency band width - Frequency spectra - GaAs - GaAs-based photodetectors - High quality - Mesoscopic structure - Mobility value - Optical-to-electrical - Optoelectronic applications - Photomixers - Photon detector - Photoresponses - Repetition time - Subpicosecond - Topdown - Ultra-fast
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