538
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Title:Design and Characterization of Plasmonic Terahertz Wave Detectors Based on Silicon Field-Effect Transistors
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Abstract:We report the first implementation of a modeling and simulation environment for the plasmonic terahertz (THz) detector based on the silicon (Si) field-effect transistor (FET) with a technology computer-aided-design (TCAD) platform. The nonresonant plasmonic behavior has been modeled by introducing a quasi-plasma electron box as a two-dimensional electron gas (2DEG) in the channel region. The alternate-current (AC) signal as an incoming THz wave radiation successfully induced a direct-current (DC) drain-to-source voltage as a detection signal in the broadband sub-THz frequency regime. The simulated dependences of photoinduced DC detection signals on structural parameters such as gate length and dielectric thickness confirmed the operation principle of the nonresonant plasmonic THz detector in the Si FET structure. We evaluated the design specifications of THz detectors considering both responsivity and noise equivalent power (NEP) as the typical performance metrics. The proposed methodologies provide the physical design platform for developing novel plasmonic THz detectors operating in the nonresonant detection mode. (C) 2012 The Japan Society of Applied Physics
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