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Title:Effects of oblique wave propagation on the nonlinear plasma resonance in the two-dimensional channel of the Dyakonov-Shur detector
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Abstract:In the Dyakonov-Shur terahertz detector the conduction channel of a heterostructure High Electron Mobility Transistor (HEMT) is used as a plasma wave resonator for density oscillations in electron gas. Nonlinearities in the plasma wave propagation lead to a constant source-to-drain voltage, providing the detector output. In this paper, we start with the quasi-classical Boltzmann equation and derive the hydrodynamic model with temperature dependent transport coefficients for a two-dimensional viscous flow. This derivation allows us to obtain the parameters for the hydrodynamic model from the band-structure of the HEMT channel. The treatment here also includes the energy balance equation into the analysis. By numerical solution of the hydrodynamic equations with a non-zero boundary current we evaluate the detector response function and obtain the temperature dependence of the plasma resonance. The present treatment extends the theory of Dyakonov-Shur plasma resonator and detector to account for the temperature dependence of viscosity, the effects of oblique wave propagation on detector response, and effects of boundary current in two-dimensional flow on quality of the plasma resonance. The numerical results are given for a GaN channel. We also investigated a stability of source to drain flow and formation of shock waves. [All rights reserved Elsevier].
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Inspec controlled terms:band structure - Boltzmann equation - electron gas - gallium compounds - high electron mobility transistors - hydrodynamics - III-V semiconductors - plasma devices - plasma nonlinear waves - semiconductor device models - shock waves - submillimetre wave transistors - terahertz wave detectors - viscosity - wave propagation - wide band gap semiconductors
Uncontrolled terms:oblique wave propagation effect - nonlinear plasma resonance - two-dimensional channel - Dyakonov-Shur terahertz detector - conduction channel - heterostructure high electron mobility transistor - plasma wave resonator - density oscillations - electron gas - plasma wave propagation - quasiclassical Boltzmann equation - temperature dependent transport coefficients - two-dimensional viscous flow - hydrodynamic model -

band-structure - HEMT channel - hydrodynamic equations - nonzero boundary current - detector response function - temperature dependence - Dyakonov-Shur plasma resonator theory - two-dimensional flow - boundary current effect - drain flow - shock wave formation - energy balance equation - GaN

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