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Accession number:12767607
Title:Terahertz plasmon amplification using two-dimensional electron-gas layers
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Source title:Journal of Applied Physics
Abbreviated source title:J. Appl. Phys. (USA)
Volume:111
Issue:9
Publication date:1 May 2012
Pages:094501 (6 pp.)
Language:English
ISSN:0021-8979
CODEN:JAPIAU
Document type:Journal article (JA)
Publisher:American Institute of Physics
Country of publication:USA
Material Identity Number:DK28-2012-018
Abstract:In this study, we present an analytical model to investigate the possibility of guiding and amplifying terahertz (THz) plasmons in a two dimensional electron gas (2DEG) layer of a hetero-structure by applying a bias electric field. This analytical model solves Maxwell equations and semi-classical electronic transport equations inside the biased hetero-structure simultaneously. It is shown that the two dimensional plasmon's properties alter vastly as the electrons are accelerated by the bias field. Four asymmetric plasmonic modes can propagate inside the un-gated 2DEG layer of the biased hetero-structure. One of these modes in the un-gated 2DEG layer is a growing mode which can be useful in the implementation of THz amplifiers. Since the modes characteristics can be controlled via biasing, design of new plasmonic devices such as modulators and switches is possible by this approach. Similar analysis has been performed in a gated 2DEG layer that shows clear changes in the two dimensional plasmon properties due to the biasing. Unlike the un-gated 2DEG layer, our efforts to find a growing mode in the gated 2DEG layer have failed. These multi-physics models lead to a better understanding of THz plasmonic sources and detectors as well as proposals on new plasmonic devices. Besides, they provide a physical insight into the electron-wave interactions inside the biased hetero-structure.
Number of references:24
Inspec controlled terms:Maxwell equations - plasmonics - terahertz wave detectors - two-dimensional electron gas
Uncontrolled terms:two-dimensional electron-gas layers - amplifying terahertz plasmons - guiding terahertz plasmons - bias electric field - Maxwell equations - semiclassical electronic transport equations - two dimensional plasmon properties - asymmetric plasmonic modes - plasmonic devices - modulators - switches - multiphysics model - electron-wave interactions - biased heterostructure
Inspec classification codes:A7320M Collective excitations (surface states) - A7870G Microwave and radiofrequency interactions with condensed matter - A7320D Electron states in low-dimensional structures

Treatment:Theoretical or Mathematical (THR)
Discipline:Physics (A)
DOI:10.1063/1.4709389
Database:Inspec