Optical analysis of Ge/MgO and Ge/BN thin layers designed for terahertz applications

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MATERIALS SCIENCE IN SEMICONDUCTOR PROCESSING

Volume: 31 **Pages:** 678-683

DOI: 10.1016/j.mssp.2014.12.047

Published: MAR 2015

View Journal Impact

Abstract

In this work, a 200 nm Ge thin film is used as a substrate to design Ge/MgO and Ge/BN layers. The optical dynamics in these devices are investigated by means of the reflectivity and the transmissivity measurements. Particularly, the details of the dielectric spectra and the values of the energy band gaps (E-g) are investigated. Below 350 THz, the construction of Ge/MgO and Ge/BN interfaces decreased the effective dielectric constant of Ge by 39% and by 76%, respectively. It also increased the quality factor of the Ge optical device from 150 to 1400 and to 940 at 300 THz. All the dispersive optical parameters are also evaluated. In addition, the direct/indirect E-g value of Ge which was determined as 1.15/0.72 eV is observed to shift down by a 0.13/0.42 and by a 023/0.54 eV for the Ge/MgO and Ge/BN devices, respectively. The sharp increase in the dielectric constant with decreasing frequency in the range of 353 273 THz, the dispersive optical parameters and the energy band gap attenuations of the optical structures are promising as they indicate the applicability of the Ge, Ge/MgO and Gel BN layers in terahertz sensing. The latter technology has a wide range of applications like medical and telecommunication devices. (C) 2014 Elsevier Ltd. All rights reserved.

Keywords

Author Keywords: Optical materials; Coating; Optical desorption spectroscopy; Dielectric properties

KeyWords Plus: INTERFACE

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Funding

Funding Agency	Grant Number
Deanship of Scientific Research (DSR), King Abdulaziz University, Jeddah	38/363/1434
DSR	

View funding text

Publisher

ELSEVIER SCI LTD, THE BOULEVARD, LANGFORD LANE, KIDLINGTON, OXFORD OX5 1GB, OXON, ENGLAND

Categories / Classification

Research Areas: Engineering; Materials Science; Physics

Web of Science Categories: Engineering, Electrical & Electronic; Materials Science, Multidisciplinary; Physics, Applied; Physics, Condensed Matter

Document Information

Document Type: Article

Language: English

Accession Number: WOS:000350513500092

ISSN: 1369-8001

eISSN: 1873-4081

Journal Information

Table of Contents: Current Contents Connect

Impact Factor: Journal Citation Reports

Other Information

IDS Number: CC6XY

Cited References in Web of Science Core Collection: 19

Times Cited in Web of Science Core Collection: 2