44
Accession number:20122915250853
Title:Spectroscopic study on ultrafast carrier dynamics and terahertz amplified stimulated emission in optically pumped graphene
Authors:Otsuji, Taiichi (1); Boubanga-Tombet, Stephane (1); Satou, Akira (1); Suemitsu, Maki (1); Ryzhii, Victor (2)
Author affiliation:(1) Research Institute of Electrical Communication, Tohoku University, 2-1-1 Katahira, Aoba-ku, Sendai 980-8577, Japan; (2) Computational Nano-electronics Laboratory, University of Aizu, Tsuruga, Ikki-machi, Aizu-Wakamatsu 965-8580, Japan; (3) JST-CREST, Chiyoda-ku, Tokyo 1020075, Japan
Corresponding author:Otsuji, T.(otsuji@riec.tohoku.ac.jp)
Source title:Journal of Infrared, Millimeter, and Terahertz Waves
Abbreviated source title:J. Infrared. Millim. Terahertz Waves
Volume:33
Issue:8
Monograph title:Terahertz Spectroscopy of Carbon Nanomaterials
Issue date:August 2012
Publication year:2012
Pages:825-838
Language:English
ISSN:18666892
E-ISSN:18666906
Document type:Journal article (JA)
Publisher:Springer New York, 233 Springer Street, New York, NY 10013-1578, United States
Abstract:This paper reviews recent advances in spectroscopic study on ultrafast carrier dynamics and terahertz (THz) stimulated emission in optically pumped graphene. The gapless and linear energy spectra of electrons and holes in graphene can lead to nontrivial features such as negative dynamic conductivity in the THz spectral range, which may lead to the development of new types of THz lasers. First, the non-equilibrium carrier relaxation/ recombination dynamics is formulated to show how photoexcited carriers equilibrate their energy and temperature via carrier-carrier and carrier-phonon scatterings and in what photon energies and in what time duration the dynamic conductivity can take negative values as functions of temperature, pumping photon energy/intensity, and carrier relaxation rates. Second, we conduct time-domain spectroscopic studies using an optical pump and a terahertz probe with an optical probe technique at room temperature and show that graphene sheets amplify an incoming terahertz field. Two different types of samples are prepared for the measurement; one is an exfoliated monolayer graphene on SiO2/Si substrate and the other is a heteroepitaxially grown non-Bernal stacked multilayer graphene on a 3C-SiC/Si epi-wafer. © Springer Science+Business Media, LLC 2012.
Number of references:36
Main heading:Graphene
Controlled terms:Epitaxial growth - Monolayers - Optical pumping - Photons - Spectroscopic analysis - Stimulated emission - Time domain analysis
Uncontrolled terms:Amplified stimulated emissions - Carrier relaxation - Carrier-phonon scattering - Dynamic conductivity - Electrons and holes - Graphene sheets - Linear energy -

Negative values - Non-equilibrium carriers - Optical probe - Optical pumps - Optically pumped - Photoexcited carriers - Photon energy - Population inversions - Recombination dynamics - Room temperature - Spectral range - Spectroscopic studies - Tera Hertz - Terahertz fields - Terahertz probes - THz lasers - Time domain - Time duration - Ultrafast carrier dynamics

Classification code:921 Mathematics - 813.2 Coating Materials - 813 Coatings and Finishes - 804 Chemical Products Generally - 801 Chemistry - 761 Nanotechnology - 744 Lasers - 741.1 Light/Optics - 711 Electromagnetic Waves

DOI:10.1007/s10762-012-9908-8

Database:Compendex