P36

Extinction engineering in graphene plasmonic resonators for terahertz applications.

Mohammad Esmaeil Daraei[1], Mehdi Abedi-Varaki[2] and Ignas Nevinskas[1]

[1]*Department of Optoelectronics, Center for Physical Sciences and Technology, Saulėtekio ave. 3, LT-10257 Vilnius, Lithuania.*

[2]*Department of Laser Technologies, Center for Physical Sciences and Technology, Savanoriu ave. 231, LT-02300 Vilnius, Lithuania.*

Email: esmaeil.daraei@ftmc.lt.

Graphene plasmonics [1, 2] enables actively tunable terahertz (THz) devices through electrically controllable carrier concentration and strong electromagnetic confinement. In this work, a graphene plasmonic resonator composed of concentric circular sectors and partial rings is investigated using finite-element method simulations. Unlike conventional studies focused on absorption, the analysis is based on the extinction cross section [3], which includes both absorption and scattering. The structure supports localized plasmonic resonances with strong coupling to incident THz radiation. Increasing the graphene chemical potential shifts the dominant resonance from approximately 2.3 to 5 THz, demonstrating efficient electrostatic tunability. Relaxation time mainly affects resonance amplitude and linewidth, while geometry and dielectric environment provide additional spectral control. Normalized extinction values that approach or exceed unity are achieved, indicating highly efficient interaction between incident radiation and localized graphene plasmons. These results highlight extinction as a useful metric for the design of tunable THz graphene plasmonic devices and sensing platforms.

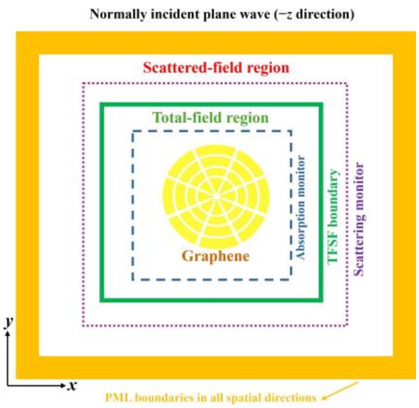

Fig. 1 Simulation configuration for the single graphene resonator, including the TFSF regions, absorption and scattering monitors, incident plane-wave excitation, and PML boundaries.

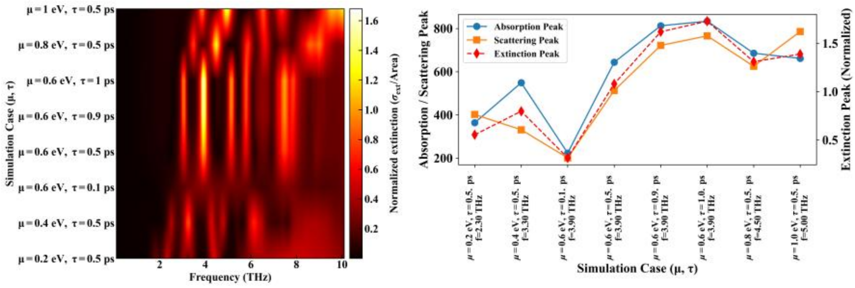

Fig. 2 Normalized extinction of the graphene plasmonic resonator for different chemical potentials and relaxation times: (a) extinction heatmap summarizing the combined dependence on μ and τ, (b) comparison of peak absorption, scattering, and extinction amplitudes.

REFERENCES

[1] Q. Bao and K. P. Loh, ACS nano 6 (5), 3677–3694 (2012).
[2] F. J. Garcia de Abajo, ACS photonics 1 (3), 135–152 (2014).
[3] J. D. Jackson, Classical electrodynamics. (John Wiley & Sons, 2021).