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Ultrafast Terahertz Frequency and Phase Tuning by All-Optical Molecularization of Metasurfaces

Yuze Hu, Tian Jiang, +10 authors Xiang'ai Cheng • Published 2 September 2019 • Physics • Advanced Optical Materials

The integration of photoactive semiconductors exhibiting strong light–matter interactions into functional unit meta-atoms facilitates effective approaches to dynamically manipulate terahertz (THz) waves. Here, a new metaphotonic modulator is proposed and comprehensively studied, which demonstrates extensive tunability of the resonant frequency and phase with the merit of ultrafast photoswitching. Specifically, parallel silicon (Si) bridges are embedded in metasurfaces to reinforce the… Expand

TLDR It is believed that the schemes regarding pump-color controllable ultrafast switching behavior introduced here can inspire more innovations across the field of ultrafast photonics and can boost the reconfigurable metamaterial applications. Expand

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Spatiotemporal Terahertz Metasurfaces for Ultrafast All-Optical Switching with Electric-Triggered Bistability

Yuze Hu, Mingyu Tong, Zhongjie Xu, Xiang'ai Cheng, Tian Jiang · Physics · Laser & Photonics Reviews · 2021

Optoelectronic terahertz switching achieved by dynamically tuning metamaterials is viewed as a major breakthrough in promoting the advancement of terahertz technology. However, the main thrust toward… Expand

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Controllable all-optical modulation speed in hybrid silicon-germanium devices utilizing the electromagnetically induced transparency effect

Junhu Zhou, Chenxi Zhang, +4 authors Tian Jiang · Physics · 2020

Abstract Incorporating auxiliary all-optical modulation speeds as optional response modes into a single metamaterial is a promising research route towards advanced terahertz (THz) applications… Expand

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Ultrafast all-optical metamaterial terahertz switch by exploiting nanoparticle-enriched substrate nonlinearity and graphene resonators

Nasrollah Karampour, N. Nozhat · Physics · Journal of the Optical Society of America B · 2021

The emergence of graphene as a new material with several extraordinary optical properties paves a way to introduce new electromagnetic devices in the terahertz (THz) band. In this paper, we have… Expand

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Ultrafast all-optical switching of dual-band plasmon-induced transparency in terahertz metamaterials

Hao Sun, Jianghua Zhang, Yuhua Tang, Hengzhu Liu, Jie Yang, Xin Zheng · Physics · Chinese Optics Letters · 2022

An active ultrafast formation and modulation of dual-band plasmon-induced transparency (PIT) effect is theoretically and experimentally studied in a novel metaphotonic device operating in the… Expand

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Ultrafast polarization-dependent all-optical switching of germanium-based metaphotonic devices

Hao Sun, Yuze Hu, +4 authors Xin Zheng · Physics · 2020

Metamaterials play an important role in the modulation of amplitude and group delay in the terahertz (THz) regime on account of their optical properties, which are rare in natural materials. Here an… Expand

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Picosecond mode switching and Higgs amplitude mode in superconductor-metal hybrid terahertz metasurface

Siyu Duan, Yushun Jiang, +11 authors Peiheng Wu · Physics · Nanophotonics · 2022

Abstract The ultrafast modulation of terahertz (THz) waves is essential for numerous applications, such as high-rate wireless communication, nonreciprocal transmission, and linear frequency… Expand

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References

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All-Optical and Ultrafast Tuning of Terahertz Plasmonic Metasurfaces

H. Cai, Qiuping Huang, +5 authors Yalin Lu · Physics · 2018

Metasurfaces have been widely used to manipulate terahertz waves due to their great potential for achieving unique electromagnetic responses. However, to realize ultrafast and efficient control of… Expand

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Ultrafast all-optical tuning of direct-gap semiconductor metasurfaces

M. Shcherbakov, Sheng Liu, +8 authors A. Fedyanin · Physics · Nature Communications · 2017

TLDR An ultrafast tunable metasurface consisting of subwavelength gallium arsenide nanoparticles supporting Mie-type resonances in the near infrared is experimentally realised with picosecond-scale large absolute reflectance modulation at low pump fluences. Expand

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Gbps terahertz external modulator based on a composite metamaterial with a double-channel heterostructure.

Yaxin Zhang, S. Qiao, +16 authors Shenggang Liu · Physics · Nano letters · 2015

TLDR This active composite metamaterial modulator is the first to achieve a 1 GHz modulation speed and 85% modulation depth during real-time dynamic tests and is the basis for the development of effective and ultrafast dynamic devices for THz wireless communication and imaging systems. Expand

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Electrically Controllable Molecularization of Terahertz Meta-Atoms

Hyunseung Jung, J. Koo, +8 authors Hojin Lee · Materials Science · Advanced materials · 2018

TLDR A new device design is provided for extensively tuning the resonance properties of terahertz metamaterials by placing graphene bridges between the metallic unit structures whose conductivity is modulated by an electrolyte gating. Expand

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Y. Srivastava, A. Chaturvedi, +4 authors Ranjan Singh · Physics · 2017

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Graphene controlled Brewster angle device for ultra broadband terahertz modulation

Zefeng Chen, Xuequan Chen, +7 authors Jian-bin Xu · Physics · Nature Communications · 2018

TLDR The effect of tunable Brewster angle controlled by graphene is demonstrated, and a highly-tunable solid-state graphene/quartz modulator is developed based on this mechanism, which ensures that the device can operate in ultra-broadband. Expand

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Research data supporting "Graphene based plasmonic terahertz amplitude modulator operating above 100 MHz"

D. S. Jessop, S. Kindness, +10 authors R. Degl'Innocenti · Physics · 2016

The terahertz (THz) region of the electromagnetic spectrum holds great potential in many fields of study, from spectroscopy to biomedical imaging, remote gas sensing, and high speed communication. To… Expand

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N. Kamaraju, A. Rubano, +6 authors T. Kampfrath · Physics · 2013

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K. Fan, A. Strikwerda, Xin Zhang, R. Averitt · Physics · Physical Review B · 2013

We present optically tunable magnetic 3D metamaterials at terahertz (THz) frequencies which exhibit a tuning range of ~30% of the resonance frequency. This is accomplished by fabricating 3D array... Expand

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Voltage-tunable dual-layer terahertz metamaterials

Xiaoguang Zhao, K. Fan, +4 authors Xin Zhang · Physics · Microsystems & Nanoengineering · 2016

TLDR The tunable metamaterial device has myriad potential applications, including terahertz spatial light modulation, phase modulation, and chemical sensing, and the scheme that is implemented can be scaled to operate at other frequencies, thereby enabling a wide range of distinct applications. Expand

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