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作者: Nikolaenko, AE (Nikolaenko, Andrey E.); Papasimakis, N (Papasimakis, Nikitas); Chipouline, A (Chipouline, Arkadi); De Angelis, F (De Angelis, Francesco); Di Fabrizio, E (Di Fabrizio, Enzo); Zheludev, NI (Zheludev, Nikolay I.)
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摘要: We provide the first demonstration of exceptional light-with-light optical switching performance of a carbon nanotube metamaterial - a hybrid nanostructure of a plasmonic metamaterial with semiconducting single-walled carbon nanotubes. A modulation depth of 10% in the near-IR with sub-500 fs response time is achieved with a pump fluence of just 10 mu J/cm(2), which is an order of magnitude lower than in previously reported artificial nanostructures. The improved switching characteristics of the carbon nanotube metamaterial are defined by an excitonic nonlinearity of carbon nanotubes resonantly enhanced by a concentration of local fields in the metamaterial. Since the spectral position of the excitonic response and metamaterial plasmonic resonance can be adjusted by using carbon nanotubes of different diameter and scaling of the metamaterial design, the giant nonlinear response of the hybrid metamaterial - in principle - can be engineered to cover the entire second and third telecom windows, from O- to U-band. (C) 2012 Optical Society of America
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地址: [Nikolaenko, Andrey E.; Papasimakis, Nikitas; Zheludev, Nikolay I.] Univ Southampton, Optoelect Res Ctr, Southampton SO17 1BJ, Hants, England
[Nikolaenko, Andrey E.; Papasimakis, Nikitas; Zheludev, Nikolay I.] Univ Southampton, Ctr Photon Metamat, Southampton SO17 1BJ, Hants, England
[Chipouline, Arkadi] Univ Jena, Inst Appl Phys, D-07743 Jena, Germany
[De Angelis, Francesco; Di Fabrizio, Enzo] Magna Graecia Univ Catanzaro, I-88100 Catanzaro, Italy
[De Angelis, Francesco; Di Fabrizio, Enzo] Italian Inst Technol, I-16163 Genoa, Italy
通讯作者地址: Nikolaenko, AE (通讯作者),Univ Southampton, Optoelect Res Ctr, Southampton SO17 1BJ, Hants, England
电子邮件地址: aen@orc.soton.ac.uk
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