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Optical bistability due to nonlinear surface plasmon polaritons in graphene

Optical bistability is found to occur under reasonable fields in a prism-air-graphene-dielectric structure. Due to this field, the reflection characteristics of the structure are modified such that the absorption peak which results in surface plasmon polariton (SPP) excitation is shifted such that bistability arises.

This effect is due to the nature of the nonlinear SPP's which have their energy and frequency as a function of the incident field [1] as well as the strong nonlinear response of graphene [2].

This nonlinear effect is determined by solving the Boltzmann transport equation and expanding the Fermi-Dirac distribution out into higher order terms [3].

A hysteresis-like curve is found when considering the optical bistability at a fixed frequency and the minimum required field and the frequency for bistability to occur has been determined.

[1] - S. Gong, T. Zhao, M. Sanderson, M. Hu, X. Chen, P. Zhang, R. Zhong, C. Zhang and S. G. Liu, Appl. Phys. Lett. 106, 223107 (2015)

[2] - A. R. Wright, X. G. Xu, J. C. Cao, and C. Zhang, Appl. Phys. Lett. 95, 072101 (2009)

[3] - N. M. R. Peres, Y. V. Bludov, J. E. Santos, A. Jauho and M. I. Vasilevskiy, Phys. Rev. B 90, 125425 (2014)

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