Nonlinear THz Plasmonics in Bi_2Se_3 Topological Insulator

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Topological insulators are a class of materials which have raised a great interest over the last decade, thanks to their intriguing conduction properties. Indeed, they are insulating in the bulk and metallic at the surface. Moreover, these metallic surface states have linear Dirac dispersion as in the case of graphene [1,2].
Bi_2Se_3 is among the most promising topological insulators, since its band structure provides only one Dirac cone, while the bulk gap is pretty large (about 300 meV) [3].
It has been demonstrated that by terahertz-infrared spectroscopy it is possible to detect the Dirac surface state by patterning thin films of Bi_2Se_3 with ribbons of width from 2 to 20 μm. In this way, a Dirac plasmon is excited and its dispersion recovers very well the theoretical dispersion, calculated by using the parameters of the Dirac carriers [4].
In this scenario, we present here our investigation on the nonlinear regime of patterned films of Bi_2Se_3 with ribbons of width of 4 and 20 μm. By exploiting the intense THz electric field of the TeraFERMI beamline at the FEL (Free Electron Laser) Fermi in Trieste [5], we were able to induce a nonlinear behaviour of the Dirac plasmon. Indeed, we observed a redshift of the plasmonic peak as the incoming THz electric field increases (up to MV/cm).

References

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