Tunable coupled graphene-metal plasmons in multi-layer structures at GHz and THz frequencies

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Over the last few years, graphene, a mono-layer of carbon atoms tightly packed into a 2D honeycomb lattice, has rapidly become the brightest stars on the horizon of materials science and condensed-matter physics, and it has revealed cornucopia of new physics and probable applications.

In recent years, an enormous interest has been surrounding the field of plasmonics, because of the variety of tremendously exciting and novel phenomena it could enable. Compared to plasmons in noble metals which have been widely studied and used, plasmons in graphene can be tuned due to the possibility of carrier density tuning in graphene by an applied electrical field, optical stimulation or chemical doping.

In this paper we investigate how one can take additional advantage of coupled metal-graphene plasmons. Hereto we derived the dispersion relation for the coupled metal-graphene plasmons in a multilayered structures. It is shown that in an optimized multi-layer structure, the coupled graphene-metal plasmon modes can depend very strongly on the electron concentration in the graphene layer. Various optimal structures with high tunability will be presented for the GHz and THz frequency range.

References

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