Plasmons in graphene nanostructures

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We study plasmon excitations in nanoscale graphene disks and edge plasmons in semi-infinite sheets and compare to the corresponding results for 2D metals within a random phase approximation.. Our results indicate that the unusual dispersion relation of graphene gives rise to interesting deviations from the usual nanoparticle plasmons and surface and edge plasmons seen in conventional metals.

A finite doped graphene sheet, with Fermi level away from the Dirac point, shows metallic properties including the plasmon excitation also at zero temperature. The density dependence of the plasma frequency is $\omega \propto n^{1/4}$, while it is $\propto n^{1/2}$ for the 2D electron system. Taking into account that the electron density of a finite doped graphene is much smaller than that of usual metals results in a plasma frequency of doped graphene which is much lower than that of metals. This special feature makes the doped graphene a good candidate for studying the intrinsic THz plasmon excitation and inspiring THz applications such as THz sensor.

References

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