Deposition and characterization of graphene for THz integrated circuit applications

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Graphene material exhibits extraordinary electronic and photonic properties allowing the confinement of low-loss surface plasmon polaritons (SPPs), which can be utilized for potential terahertz applications [1]. Graphene SPPs have many advantages compared to noble metal SPPs. Its optical properties can be tuned through chemical doping or externally applied voltage bias, supporting a wide range of frequencies from infrared to terahertz frequencies. In previous noble metal based SPP devices, once the device is fabricated, its tuning at different frequencies is not possible. Graphene SPPs are a viable approach for dynamic tuning of the plasmonic devices. In addition, they can be utilized to achieve tighter confinement and lower losses. Also, the propagation of modes lies in subwavelength dimensions that are beyond the diffraction limits. These features allow the graphene to be used with the advantages of unrivalled speed, low driving voltage, low power consumption and a small physical signature. Moreover, it can be used for nonlinear applications as Kerr-type nonlinear or plasmonic metamaterial.

It is an emerging component in the design of upcoming technologies like waveguides, sensors, plasmonic passive components and devices. It has marked its impression in both low as well as high terahertz frequency regions. Graphene oxide can be prepared from natural graphite powder using modified Hummer's method and after its thermal or chemical reduction, deposition of graphene can be done by various methods like mechanical exfoliation, spin-coating, epitaxial growth, chemical vapor deposition (CVD), wet chemical routes, etc.

This paper presents the deposition of graphene using spin-coating method [2], characterized with the help of infrared (IR) spectroscopy, photoluminescence spectroscopy and scanning-electron microscopy (SEM), energy dispersive

Xray analysis (EDX), etc. Figure 1 shows typical SEM images and EDX spectrum of the graphene. It can be further used to design and characterize microstrip or coplanar line THz integrated circuits. Figure 1(a), (b) and (c) represent the SEM images of the deposited graphene material on Si/SiO₂ dielectric substrate, showing the presence of graphene on dielectric.

Figure 1: (a, b) SEM images and (c) EDX spectrum of graphene material

References

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