

Luminescence Properties of Graphene

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Due to its unique and outstanding physical properties, graphene has attracted considerable scientific attention in recent years. Graphene-based applications demonstrate particular promise in the field of photonics and optoelectronics; however, its unique optical and electronic properties have not yet been fully exploited. Luminescence has been achieved through various methods, and suggests a number of potential applications such as light emitting diodes, display and lighting devices, and biological labelling and imaging [1]. Luminescence has been widely studied for graphene-related structures such as carbon nanotubes, graphene oxide, and graphene quantum dots [1]. The luminescence of pristine graphene, however, has received less attention. The photoluminescence of pristine graphene has been achieved using ultrafast laser excitation [2], while the electroluminescence of pristine graphene has been demonstrated by an applied source-drain voltage [3] and by electron tunneling in a scanning tunneling microscope [4].

In this work, we investigate the luminescence properties of pristine graphene and graphene-based field effect transistor devices in order to gain insight into the light-emitting properties of graphene and to further the development of graphene-based optoelectronics devices. Graphene samples were prepared by mechanical exfoliation, and devices were fabricated via electron beam vapor deposition of gold contacts. Raman spectroscopy, electronic transport measurements, and luminescence spectroscopy were used to characterize the graphene and its light emitting properties. The effects of various experimental parameters on the luminescence properties were investigated. As an example, the electroluminescence of a graphene field effect transistor in ambient conditions is shown in Figure 1, where (a) and (b) illustrate the device set-up, and (c) shows the resulting electroluminescence spectrum under simultaneously applied source-drain and gate voltages.

References

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Figures

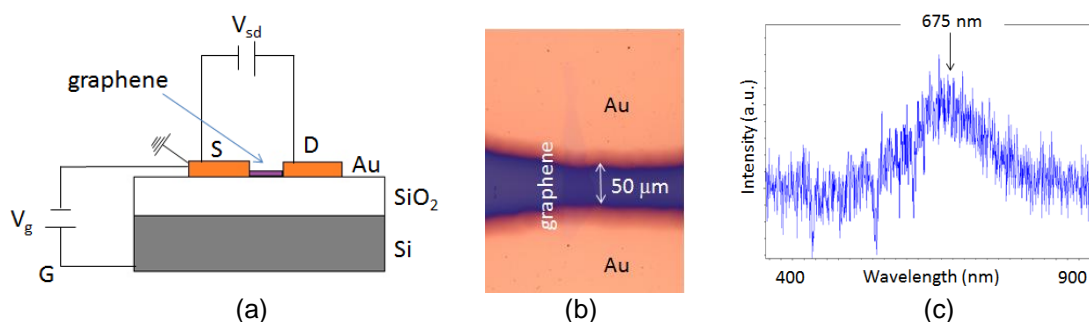


Figure 1. Electroluminescence of a graphene field effect transistor: (a) schematic of the device used for excitation, showing source (S), drain (D), and gate (G) electrodes, applied source-drain voltage (V_{sd}) and gate voltage (V_g); (b) Optical microscope image of the device (top view); (c) electroluminescence spectrum in ambient conditions under applied V_{sd} and V_g .