Ultrahigh performance of dye molecule enhanced graphene photodetector

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Abstract

We present a novel graphene photodetector with broad spectral photo-response fabricated by using dye molecules for the realization of high performance optoelectronic device. We report the ultrahigh performance of a hybrid photodetector of dye molecules and graphene, covering wavelengths in the infrared to ultraviolet range with high quantum efficiencies. The main causes underlying the high performance of the hybrid photodetector are the enhancement of the absorption of light in graphene and the implementation of photocurrent gain. Due to the strong light absorption and the gain mechanism arising from dye molecules the hybrid photodetector generates much higher photocurrents (~ mA at zero gate voltage) than a pure graphene photodetectors (where the current is ~ pA) from the same amount of light. The proposed dye molecule sensitized graphene photodetectors, showing excellent weak signal detection with high responsivities (~100 A/W), uniform photoresponse, high speeds (~ millisecond), and broad spectral bandwidths (400 nm < λ < 1000 nm) can be applied to graphene based optoelectronic devices.

References

[1] Bonaccorso, F., Sun, Z., Hasan, T. & Ferrari, A. C., Nature Photon., **4** (2010), 611–622.
[2] Mueller, T., Xia, F. & Avouris, P., . Nature Photon., **4**, (2010), 297–301.
[3] Konstantatos G., et. al., Nature Nanotechnol., **7**, (2012), 363-368

Figures

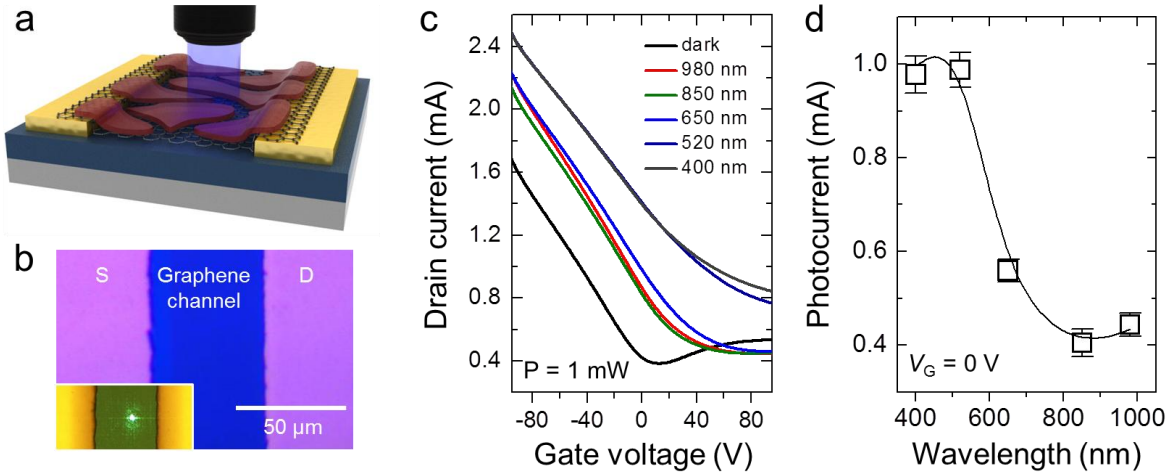

Figure 1. (a) Schematic illustration of dye molecule enhanced graphene photodetector. (b). Optical image of fabricated device. Inset denotes incident laser beam to the active area of photodetector. (c) Transfer characteristics of dye molecule enhanced graphene photodetector with respect to various wavelength of incident laser with fixed power of 1mW. (d) Photocurrent of dye molecule enhanced graphene photodetector as a function of wavelength of incident laser.