

Prototype hybrid graphene quantum dot photodetector for VIS, NIR and SWIR

A.M. Goossens, E. Puma, J. Piqueras, J. C. Cifuentes, G. Navickaite, T. Lasanta, I. Nikitskiy, R. Pérez, G. Konstantatos, F. Koppens

ICFO – The Institute of Photonic Sciences, Av. Carl Friedrich Gauss, 3, 08860 Castelldefels (Barcelona), Spain
stijn.goossens@icfo.es

Abstract

Hyperspectral imaging is becoming attractive in many areas. Extending imaging capabilities of visible cameras to the short wave infrared wavelength ranges enables powerful night vision systems. This combination of spectral ranges can also provide farmers with useful information about the hydration levels of their crops. Moreover, relevant health information such as the oxygen saturation level can only be extracted by employing spectrometric measurements in different wavelength ranges. Currently, hyperspectral imaging is performed by using different light sensitive materials for each wavelength range. This presents problems with the compactness and facile integrability of hyperspectral systems. There is currently a large need for one hyperspectral detector technology that can not only measure in the visible (VIS), but also in the near infrared (NIR) and short wave infrared (SWIR).

Previously we demonstrated a hybrid graphene quantum dot photo detector that is sensitive to both visible light and short wave infrared radiation [1]. The broad spectral range combined with its extremely low noise-equivalent power smaller than a fW make it a promising light sensing technology. PbS colloidal quantum dots are deposited on top of graphene and induce a photogating effect when exposed to radiation. By tuning the size of the quantum dots, the band gap can be tuned and hence the absorption range. We have demonstrated absorption from the visible up to 1.6 μm .

As a proof of concept for the robustness and facile integrability with wearables we have developed a demonstrator comprising an ultrasensitive photo detector on a PEN substrate and a customised read-out board (see Fig. 1). This read-out board has balanced read-out, integrated amplification and video frame rate imaging capabilities. In this poster we will embed a live demo of a hybrid graphene quantum dot photo detector.

The hybrid graphene quantum dot photo detector is based on large area CVD-graphene. Moreover the colloidal quantum dots are compatible with large volume production wet-chemistry methodologies and can be deposited atop substrates using standard solution-processed large area deposition techniques. These factors make it possible to integrate the photo detectors with currently existing electronic circuit fabrication processes. This paves the way for volume production and commercialization

References

[1] G. Konstantatos, M. Badioli, L. Gaudreau, J. Osmond, M. Bernechea, F. P. Garcia de Arquer, F. Gatti and F. H. L. Koppens, *Nature Nanotechnol.*, **7** (June 2012). Hybrid graphene-quantum dot detectors with ultrahigh gain.

Figures

Fig. 1 Photograph of the first version of the prototype of the hybrid graphene quantum dot light detector. The detector is interfaced with a read-out box and the signal is displayed on an iPad.

