Flexible and transparent near-infrared optical sensors enhancing wearable smart materials

Emre O. Polat

E. Puma, S. Gupta, T. Galan, C. Monestario, G. Navickaite, I. Nikitsky, S. Goossens, G. Konstantatos, F.H. Koppens

The Institute of Photonic Sciences, Av. Carl Friedrich Gauss 3, Castelldefels, Spain

eric.puma@icfo.eu

Abstract

Empowered by a growing class of 2D-enabled smart materials, fully flexible electronics are poised to redefine everyday devices by slimming bulky forms and adding novel function. We introduce a new member to this class of smart materials: hybrid graphene and quantum dot (GQD) photodetectors integrated on flexible, transparent substrates. Other works have demonstrated flexible photodetection with perovskites [1], functionalized graphene [2], and organic photodiodes [3]. The GQD photodetectors presented here show competitive performance in the visible (400-800nm), and, uniquely, show high sensitivity in the near-infrared (up to 2000nm) enabling wellness and night-vision sensing technologies [4]. Moreover, GQD sensors have great scaling potential as they can be manufactured in a low cost sheet-to-sheet or roll-to-roll process. As a proof-of-concept, we implement flexible GQD sensors in a prototype optical heart rate monitor, sensitive enough to measure a pulse in ambient light conditions.

References

[1] H. Deng et al., Nano. Lett.,12 (2015) 7963
[2] N. Liu et al., Nano. Lett., 7 (2014) 3702
[3] A. Falco et al., ACS Appl. Mater. Interfaces, 13 (2014) 10593
[4] Goossens et al., arxiv.org:1701.03242 [cond-mat.mes-hall]

Figures

Figure 1: Flexible PEN coated with graphene and a QD thin film (20nm) is highly visibly transparent and photosensitive. These sensors can be integrated into wearables, flexible displays, and more.

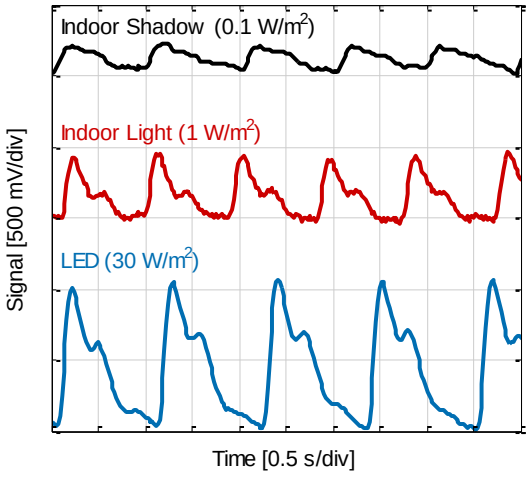

Figure 2: Pulses measured using a flexible heart rate sensor in various lighting conditions, including ambient. The top two traces are measured by the transmission of standard fluorescent office light through the finger.