Graphene as enabler for broadband image sensors integrated with CMOS and flexible platforms

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Integrated circuits based on CMOS (complementary metal-oxide semiconductors) are at the heart of the technological revolution of the past 40 years, as these have enabled compact and low cost micro-electronic circuits and imaging systems. However, the diversification of this platform into applications other than microcircuits and visible light cameras has been impeded by the difficulty to combine other semiconductors than silicon with CMOS.
We show a broadband image sensor based on the monolithic integration of a CMOS integrated circuit with graphene. [1] The graphene is covered with colloidal quantum dots to sensitize it to UV, visible and infrared light (300 – 2000 nm). [2,3] This demonstration of a broadband graphene-CMOS image sensor is a major leap towards 3d integrated circuits based on 2d materials and Si-CMOS that can perform even more complex tasks than Si-CMOS alone.
Furthermore, we will show a prototype wellness monitor based on graphene colloidal quantum dot hybrid detectors. We leveraged graphene's flexible and transparent properties to create a wearable device that is conformal to the human body so that it can extract vital signs such as heart rate, breathing rate and oxygen saturation more reliably than conventional devices.

References

[1] Goossens et al., Nature Photonics 11 (June 2017)
[2] G. Konstantatos, et al., Nature Nanotechnol., 7 (June 2012)
[3] Nikitskiy et al., Nat. Commun., 7 (June 2016)

Figures

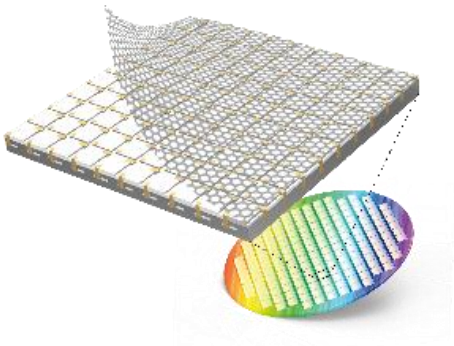

Figure 1: Artistic impression of the image sensor die coated with graphene.

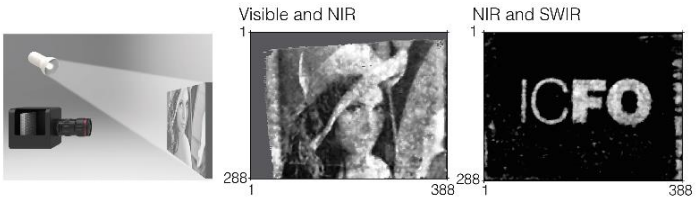

Figure 2: From left to right Digital camera setup representation, Visible light photograph of standard image reference 'Lena' and Near infrared and short wave infrared light photograph of a logo cut out of a metal sheet.

Figure 3: Photograph of the packaged image sensor.