Measuring the atmosphere's night glow with hybrid graphene – quantum dot photodetector at room temperature

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Abstract

Night vision cameras can be used in the automotive industry, security, aviation and everyday civilian life. Current systems based on silicon technology rely on active illumination in the near infrared (NIR) which is power consuming and can blind other night vision cameras of the same type. During the night the earth's atmosphere is radiating short wave infrared (SWIR) light that could be used as a natural light source enabling passive night vision. This light is called night glow or air glow ([1], figure 1a). Existing technologies such as InGaAs photo diodes are costly and require cooling for achieving the high sensitivity needed to detect night glow. Increased sensitivity and reduced price of the SWIR detectors would open new fields of application. The main reason for the high cost of existing technologies is non-compatibility with CMOS technology. Here we present a detector that is CMOS compatible and highly sensitive in the SWIR range.

Our sensor is a hybrid system benefiting from high graphene carrier mobility and the colloidal quantum dot's tunable light absorption [1]. The absorption peak of the quantum dots can be adjusted to match the peak of the atmosphere night glow, which is around 1600 nm (see figure 1b). High graphene carrier mobility gives the detector a large internal gain up to 10^8 A/W. This leads to a noise equivalent irradiance at 1600 nm of $<2 \cdot 10^{-6}$ W/m^2. To prove the relevance and high sensitivity of the technology we will present an experiment where we measure night glow radiation with a single pixel SWIR detector

The CMOS compatibility of our detectors will facilitate scaling to camera systems with small pixel sizes. These cameras will not require cooling and can be used for night vision without additional light source.

References

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[2] 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

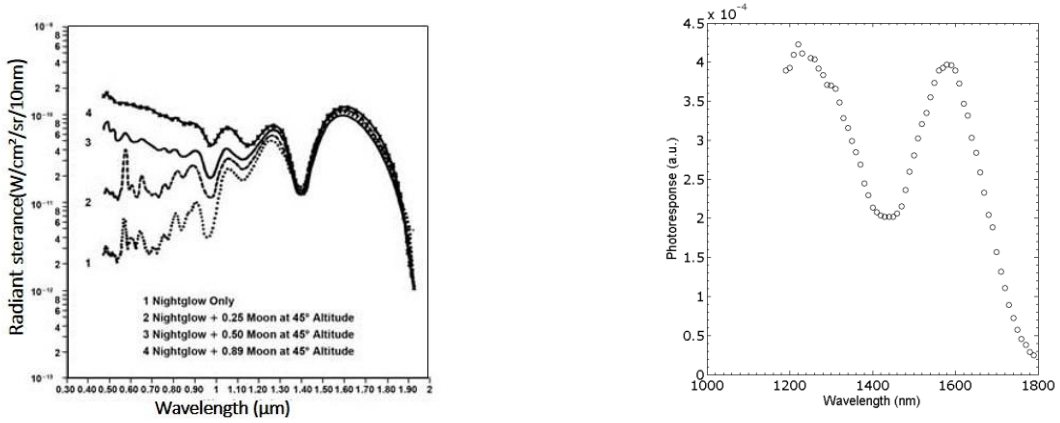

Figure 1 (a) Spectrum of the night glow [1]. (b) Responsivity dependence on illumination wavelength of our photodetector