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Reconciling organic photodetectors and low-cost instrumentation

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Organic photodetectors (OPD) can now compete with silicon photodiodes in term of detectivity.[1],[2] Nevertheless, the detection at low irradiance needs the use of expensive instruments such as low noise preamplifier in order to measure photocurrents as low as few pA. This is clearly in contradiction with the low-cost process for the fabrication of OPDs.

In this presentation we will discuss about two options that could match with cheap instruments for the detection. The first option considers the possibility to have a direct amplification of the photocurrent using the gain of the device. To do that, the device architecture has to be modified in order to enhance the gain. In case of photoresistance architecture, we show that the photo-generated carriers can induce a significant modification of electric field that can trigger additional carrier injection from the contacts. The second option can be simply achieved using organic photodiodes operating in the open-circuit voltage (V_{oc}) mode. Unlike photocurrent, the light-dependent nature of V_{oc} offers an extended linear dynamic range at low irradiance. For instance, an irradiance as low as 6×10^{-8} W/cm^2 gives rise to a photovoltage as high as 1.1 mV (that can be measured with a simple voltmeter) whereas the corresponding photocurrent is as low as 136 pA. Obviously, this low current cannot be accurately measured with low cost instrument.

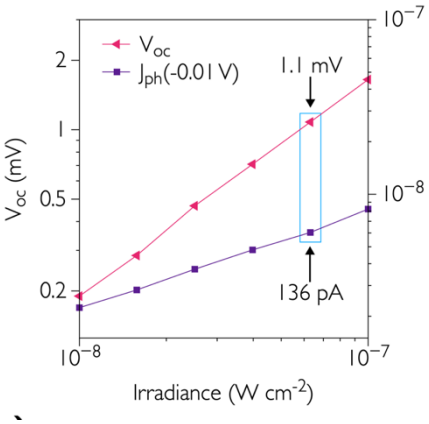

Figure 1: Comparison of the V_{oc} and the photocurrent signals at the same irradiance and for the same photodetector

[1] M. Kielar et al. *Adv. Electron. Mater.* **2018**, 1700526
[2] M. Kielar et al. *Scientific Reports* **2016,** 6, 39201