

# Low-Noise, Ultrafast Bulk-Heterojunction Organic Photodetector

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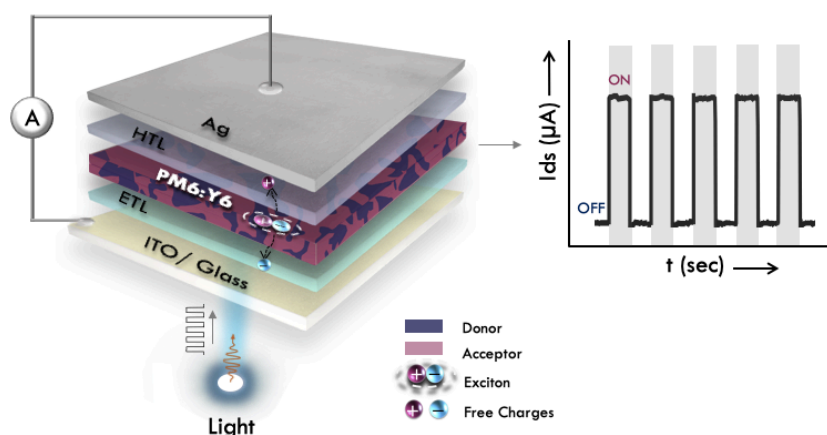
## Abstract

High performance self-powered photodiodes that feature high sensitivity and fast photoresponse with low noise that covers spectral range from several near-infrared to ultraviolet even at low light intensity is rare. Here, we demonstrate solution-processed ultrafast self-powered photodetector based on PM6:Y6 organic material. A detailed characterization of bulk-heterojunction PM6:Y6 photodiode reveals the influence that thickness of photoactive material has on the dark current and electronic noise at low frequency. At room temperature, the photodetector exhibits -3 dB cut-off frequency of ~780 kHz, dark current density of  $\sim 14.9 \times 10^{-11}$  A/cm<sup>2</sup> at zero bias and load resistance dependent response time ranging from 800-130 ns (Figure 1), linear dynamic range over 140 dB, maximum responsivity of 0.57 A/W<sup>-1</sup>, detectivity (ability to detect low light signals)  $\sim 10^{13}$  Jones. We also explore the key response time limiting factors and compare our photodetector to current organic and standard Si photodetectors (S1133). Considering various performance merits in comparison to traditional Si photodetector, our photodetector is found to rival low-noise Si photodetector.

## References

- [1] C. Fuentes-Hernandez, W.-F. Chou, T. M. Khan, L. Diniz, J. Lukens, F. A. Larrain, V. A. Rodriguez-Toro and B. Kippelen, *Science*, 370 (2020), 698–701.
- [2] G. Simone, M. J. Dyson, S. C. J. Meskers, R. A. J. Janssen and G. H. Gelinck, *Advanced Functional Materials*, 30 (2020), 1904205.

## Figures



**Figure 1:** Schematic representation of PM6:Y6 based bulk-heterojunction based organic photodetector.