Article

High-Performance Circularly Polarized Light-Sensing Near-Infrared Organic Phototransistors for Optoelectronic Cryptographic Primitives

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Abstract

Chiral photonics has emerged as a key technology for future optoelectronics, such as quantum information and encryption, by making use of photonic waves from enantiomeric structures. An inevitable challenge for realizing such chiral optoelectronics is the development of near-infrared circularly polarized (NIR CP) light-sensing photodetectors that convert optical power and circular polarization direction into distinguishable electrical signals. Herein, a simple and promising strategy for high-performance NIR CP light-sensing organic phototransistors (NIR CPL-OPTRs) applicable to highly secure optoelectronic encryption is proposed. By directly assembling a standalone cholesteric liquid-crystal network film in a thin-film NIR CPL-OPTR, remarkable responsivity and distinguishability are achieved. The synergetic effect of amplification of the photocurrent signal by the applied electric field and improved light absorption by the reduced reflection in the multilayered structure leads to high responsivity. As a proof-of-concept, the chiral phototransistor arrays are demonstrated as a physically unclonable function device and exhibit enhanced cryptographic characteristics. High-performance near-infrared circularly polarized light-sensing organic phototransistors are realized by directly assembling a standalone cholesteric liquid-crystal network film in the NIR-sensing organic phototransistor based on a small-bandgap polymer semiconductor. A physical unclonable function device based on the chiral phototransistor arrays can enhance cryptographic characteristics by encoding the polarization direction of the CP light.

Citations (3) References (70)

... Supplementary Fig. 20c shows the D* of the vertical phototransistors as a function of the incident irradiance. In the accumulated region, the calculated maximal D* can reach ≈1.2 × 10 13 Jones under an incident intensity of 0.4 μW/cm 2 , which is superior to some of the reported narrow bandgap organic-based NIR photodetectors [38][39] [40] [41] . When we extended the NIR light to 740 and 940 nm, the PTCDI-C8 nanowires VPTs have also validated excellent NIR light photoresponse, which are similar to the results obtained at 850 nm NIR light, as shown in Supplementary Figs. ...

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