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BIAS TRIGGERED MODE-SWITCHABLE PHOTODETECTOR FROM BROADBAND TO NIR-SELECTIVE

Bias-switchable photodetector toggles between broadband and NIR-selective modes with superior detectivity.

Photodetector diodes are critical components in numerous applications ranging from surveillance and medical imaging to optical communication and remote sensing. However, conventional photodetectors struggle with distinguishing between different types of light, particularly when transitioning between detection modes. This issue is further compounded by the need for high performance across diverse light, temperature, and physical conditions. There are currently no options in the market that offer the flexibility to switch between a broad-band detection mode and a visible-blinded near-infrared (NIR) detection mode.

To address this issue, Purdue researchers have developed a new type of high-performance Si photodetector, a diode that demonstrates remarkable responsivity and detectivity. The photodetector diodes are composed of a highly conductive polymer, poly (3,4-ethylene dioxythiophene (PEDOT), coated onto black-Silicon (b-Si). Synthesis of the PEDOT was done using oxidative chemical vapor deposition, allowing for remarkable step coverage and superior electrical properties compared to conventional gas-phase synthesis. Due to the unique composition of the photodetector, a superior peak detectivity that is three and seven times higher than that of a conventional PEDOT:PSS-covered b-Si and planar-Si detectors, respectively, is demonstrated. These diodes can switch between a broad-band detection mode and a visible-blinded near-infrared (NIR) detecting mode based on the biasing voltage applied to the diodes' electrodes. These two different modes of operation offer flexibility in terms of detection strategy, thereby enabling the personalization of detection systems based on specific application needs and conditions.

Related Publications:

Technology ID

2022-LEE-69791

Category

Aerospace & National Security/Defense, Electronics, & Surveillance Technologies
Energy & Power Systems/Energy Storage
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"Hybrid Silicon-Polymer Photodetector Engineered Using Oxidative Chemical Vapor Deposition for High-Performance and Bias-Switchable Multi-Functionality." Advanced Functional Materials 32, no. 29 (2022): 2201641. https://doi.org/10.1002/adfm.202201641

Technology Validation:

- Under 625 nm light, photodetector demonstrates the responsivity of 1.14 A W^-1, detectivity of 1.37Ã—10^13 Jones and conductivity of 3,000 S cm^-1

- Responsivity is 3.22x higher than that of PEDOT:PSS/planar-Si photodetector under 625 nm light

Advantages:

- No NIR-filter required

- Fast detection time (multiple images not required to create enhanced image)

- Inhibition of surface recombination during charge transport

- Superior peak detectivity when compared to traditional PEDOT covered b-Si diodes

Applications:

- Vision system for navigation, night vision, motion tracking, and bio-sensing

TRL: 3

Intellectual Property:

Provisional-Patent, 2022-11-30, United States

Utility Patent, 2023-11-30, United States

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