

Phototransistor Array Based on Plasma-Engineered Amorphous Metal Oxide Semiconductors with Ferroelectric Dielectrics

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The potential for next-generation electronic applications has expanded significantly with the development of energy-efficient, high-performance broadband photodetectors utilizing cost-effective amorphous metal oxide semiconductors. Current commercially available photodetectors use various semiconductors to detect light across different wavelengths, from ultraviolet (UV) to near-infrared (NIR). However, their versatility is limited by the need for specific materials to target different wavelengths. This study explores the use of indium gallium zinc oxide (IGZO) as a metal oxide semiconductor, eliminating the need for additional external photo absorption layers. To enhance charge carrier generation and create subgap states in the IGZO film, hydrogen (H₂) plasma treatment was applied, enabling wide-spectrum detection from UV to NIR without extra layers. Furthermore, a ferroelectric and high-k dielectric was introduced as the gate dielectric to induce a strong electric field in the channel, resulting in low-power operation. The H₂ plasma-treated IGZO phototransistors demonstrated ultra-high photoresponsivity and detectivity over a broad range of wavelengths (400 to 1000 nm), making them a promising candidate for next-generation optoelectronic devices. This study presents a favorable approach for advancing energy-efficient, cost-effective, and high-performance broadband photodetectors.