Researchers realize a high-speed uni-traveling-carrier photodiode

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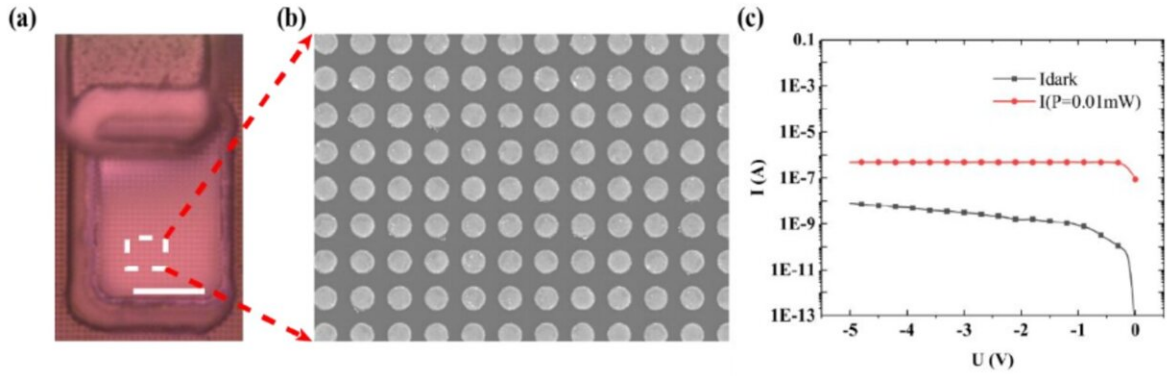

(a) UV optical image of an array of nanodisk and signal-contact on the UTC photodiode. The scale bar is 5 μm. (b) SEM image of an array of nanodisk antenna structures. The scale bar is 2 μm. (c) Dark current and photocurrent characteristics for the device. Credit: *ACS Applied Electronic Materials* (2022). DOI: 10.1021/acsaelm.2c01052

Photodiodes with high speed and efficiency are particularly advantageous to the exponential growth of data communication traffic. However, vertical detector design still faces difficulties in improving high responsivity while maintaining low dark current and high bandwidth.

In a recent study published in *ACS Applied Electronic Materials*, a research team led by Prof. Wang Liang and Prof. Han Zhengfu from the

University of Science and Technology of China (USTC) of the Chinese Academy of Sciences designed a low-dark-current and high-bandwidth photodiode with improved responsivity.

The researchers achieved epitaxial structure growth with low defect density and high doping accuracy by adjusting the growth parameters such as MOCVD temperature, V/III ratio, and doping concentration.

They designed a plasmonic InP/InGaAs uni-traveling-carrier photodiode with optical antenna arrays, which exhibits a low dark current of 2.52 nA at a −3 V bias voltage, a high bandwidth of over 40 GHz, and a high responsivity of 0.12 A/W. The absorption efficiency of the photodiode shows a 2-fold improvement using plasmonic resonance generated by nanodisks at 1550 nm.

Compared with other devices, its responsivity is enhanced by 147% and its signal-to-noise ratio is higher, which helps provide a high-quality domestic chip for high-speed optical interconnection networks.

This study provides the core chip for optical receiver modules applied to data centers, breaking down barriers in key hardware technology for higher-speed optical modules in the future.

More information: Bojian Zhang et al, Plasmonic Resonance-Enhanced Low Dark Current and High-Speed InP/InGaAs Uni-Traveling-Carrier Photodiode, *ACS Applied Electronic Materials* (2022). DOI: 10.1021/acsaelm.2c01052

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