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### Surface-illuminated ultra-fast Si and PbSe infrared detectors with enhanced efficiency via periodic microstructures

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CMOS-process-compatible silicon (Si) based detectors could lead to a cheaper and better integrated fibre-optic communication system. However, traditional Si photodiodes with a weak absorption coefficient of Si can hardly achieve a high External Quantum Efficiency (EQE) and a high data transmission rate simultaneously at near-infrared wavelengths used for data communication. In this work, in order to increase the EQE of Si based MSM photodiodes while maintaining a high-speed operation, periodic arrays of cylindrical-shaped photon-trapping holes are integrated in thin absorption regions between metal fingers. The holes are arranged in square and hexagonal lattices with different designs of hole diameter, depth and period. Theoretical and experimental study reveals that a beam of vertically incident light is guided laterally and confined in the nanostructured Si film. Si based MSM photodiodes with integrated photon-trapping hole structures has an enhanced EQE of 61% and an ultra-fast impulse response (full-width at half-maximum) of 25 ps. PbSe film is prepared on Si by an evaporation process to realize broadband high efficiency up to 1550 nm. By integrating photon-trapping holes, the absorption and EQE of PbSe based MSM photodiodes are also significantly improved. The detector with microstructured holes exhibits over 500% enhancement of EQE compared to the device without hole structures.

#### Biography

Jun Gou studied Optical Engineering at University of Electronic Science and Technology of China (UESTC) and graduated as MS in 2010. He received his PhD degree in 2014 at the same institution. Now he works at School of Optoelectronic Science and Engineering, UESTC. He is dedicated to the research of uncooled infrared and terahertz detectors. In recent years, he has published more than 30 research articles in SCI(E) journals, co-authored 1 English monograph and won the first prize of Science and Technology Progress of Sichuan Province and more than 20 national invention patents.

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