NIR-Sensitivity Enhancement of a Back-Illuminated Single-Photon Avalanche Diode Through Backside Scattering Patterns

P2.06

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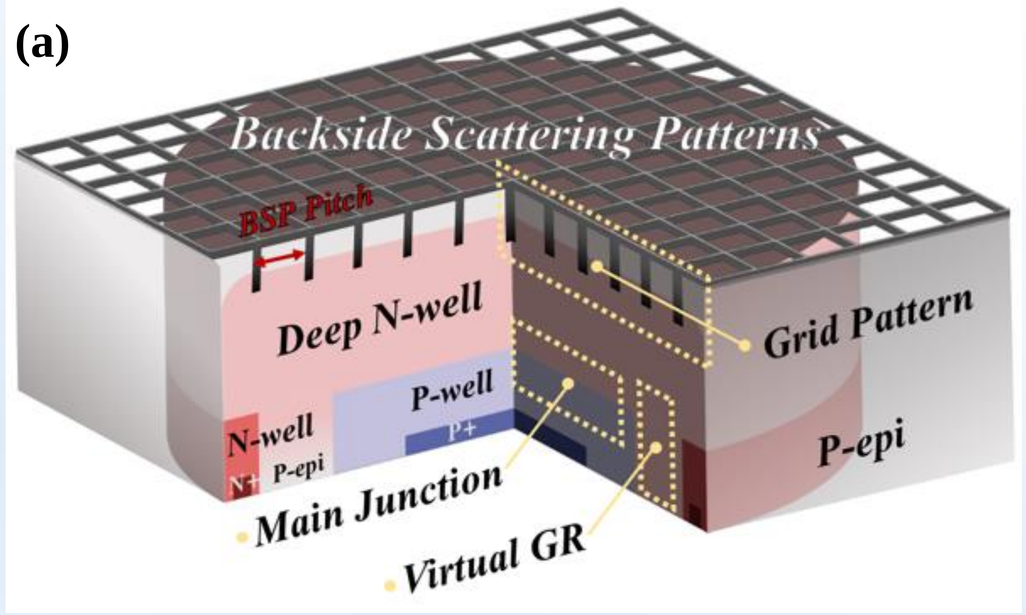
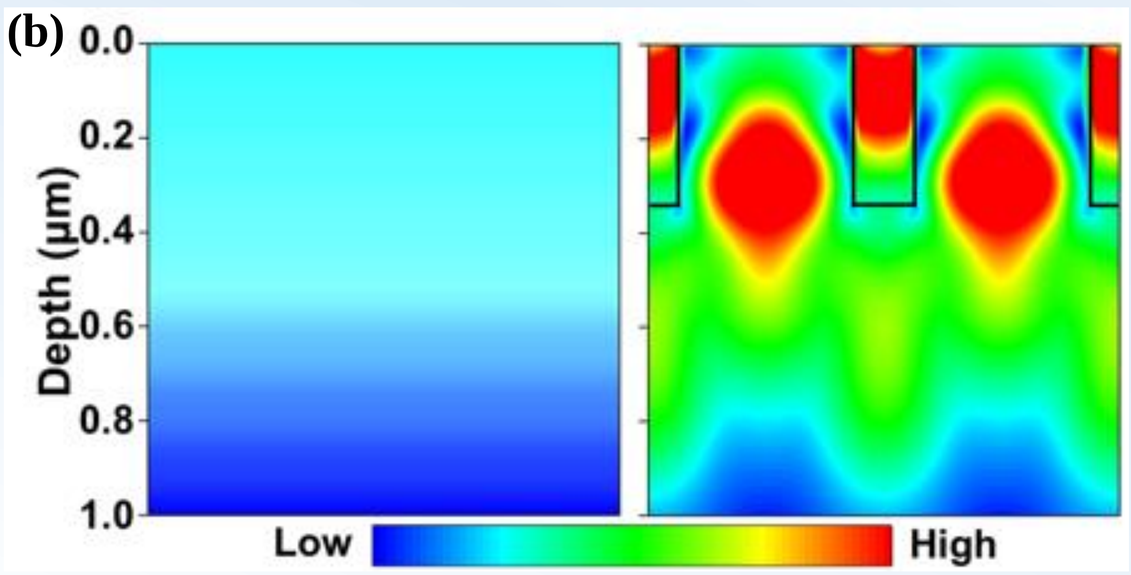
Device Structure and Simulation Results



- **Main Junction: P-well / Deep N-well**
- **Guard Ring: Virtual guard ring**

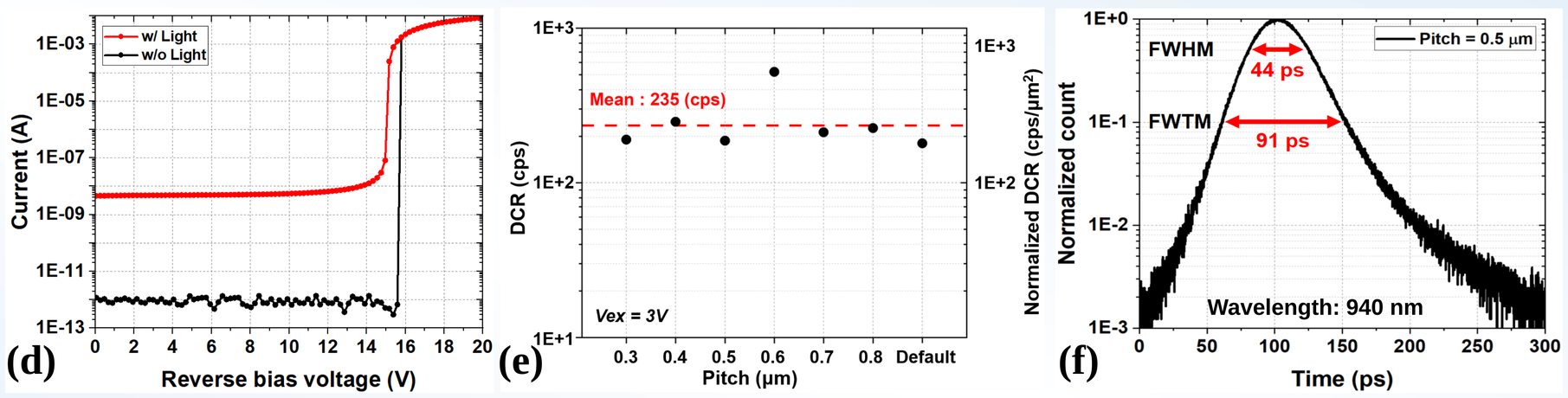
(a) Structure of a BI SPAD with the BSP for diffraction.

(b) Simulation results of light intensity profile: default SPAD and SPAD with a grid pitch of 0.5 μm at the wavelength of 940 nm.



The backside scattering pattern (BSP) of a grid pattern with various pitches is implemented in SPAD to induce diffraction.

Measurement Results



(d) I-V characteristic of the default BI SPAD under dark and illuminated conditions.

(e) DCR and normalized DCR of BI SPAD according to the grid pitch.

(f) Timing jitter measurement result of the BI SPAD with 0.5 μm grid pitch at Vex = 3V

The 940 nm PDP values of SPADs increase significantly with BSP, especially the maximum 940 nm PDP increase ober 100% compared to the default SPAD at Vex = 3V.

Conclusion

- **The PDP measurement results for various grid pitches of BSP indicate that a 0.5 μm grid pitch optimizes the grid pattern, enhancing the 940 nm wavelength PDP over 100%.**