

Ultra-Fast High-Responsivity Graphene-Silicon Schottky Avalanche Photodiode

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Graphene-Silicon (Gr/Si) Schottky photodiodes are promising candidates for high-speed broadband. Owing to the high carrier mobility, broadband light absorption, and high conductivity of the graphene, the collection efficiency of photogenerated carriers can be enhanced, however careful design of the photodiode structure is required to achieve high-speed operation. We have designed and characterised a high-speed Gr/Si Schottky photodiode based on impact avalanche ionization. A circular geometry uniformly enhances the electric field at the edge of the active area (of 1260 μm^2) using round electrodes to optimize the carrier collection efficiency as shown in figure 1 (a). The device, shown in figure 1 (b), is characterized by an automated scanning photocurrent microscopy that can perform a 5D scan including laser power, applied voltage, and two spatial dimensions. From the photomapping, the photocurrent is observed to be uniform across the graphene-Silicon region (figure 1 (c)). Our findings reveal an ultrafast response time of 4ns at a low applied voltage of 0.1V as shown in figure 2 compared to recent studies [1, 2]. This shows potential applications of our design for low cost, high-speed, broadband and compact PDs.

References

[1] Liu, X., Ning, H., Lv, J., et al., *Applied Physics Letters*, 7 (2023) 071105.

[2] Ji, P., Yang, S., Wang, Y., et al., *Microsystems & Nanoengineering*, 1 (2022) 9.

Figures

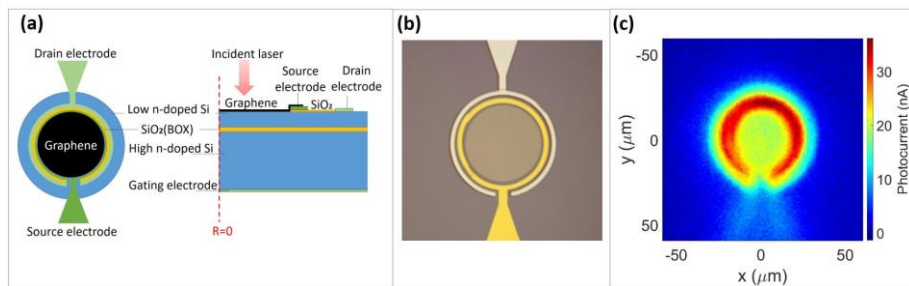


Figure 1: (a) Design, (b) Optical image, and (c) photocurrent scan of Gr/Si Schottky photodiode.

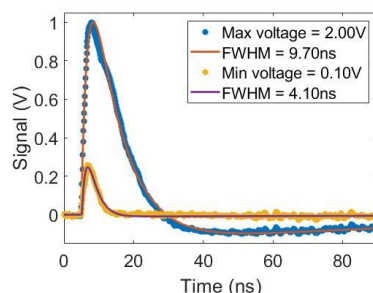


Figure 2: Response time of Gr/Si photodetector at different voltages.