Graphene Photodetector Enhanced by a Planar Yagi-Uda Antenna

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A planar Yagi Uda antenna enhances thin-film emitters and photodetectors (PDs). A planar photodetector using thin layers, e.g. 2D materials like Graphene as an active medium layer and adding dielectric layers, has been studied to enhance photon emission and detection from visible to infrared wavelengths [1-5]. Furthermore, adding dielectric interlayers in this planar detector configuration has been proposed [4] to improve coupling efficiency and beam focusing efficiency. The fabricated device configuration uses Graphene as an active medium, Al_2O_3 as dielectric and Al as reflector (Fig. 1a) [5]. We illuminate the PDs with white light from the top and measure their photoresponse under 100, 75 and 50 mV bias via the electrical contacts. 30 PDs were measured and compared with 30 reference devices without the antenna, i.e. without the reflector (Fig. 1b). An average enhancement of a factor of 2.02 was measured, in agreement with our simulations predicting a factor of 2.4. This enhancement is attributed to enhanced absorption in the graphene due to electric field enhancement by the antenna. Our simulations predict a maximum enhancement of a factor of 13 with additional layers for the antenna [4]. This Graphene photodetector can be applied to almost any substrate, especially CMOS chips. Moreover, the antenna concept can be applied to any thin active medium.

References

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Figures

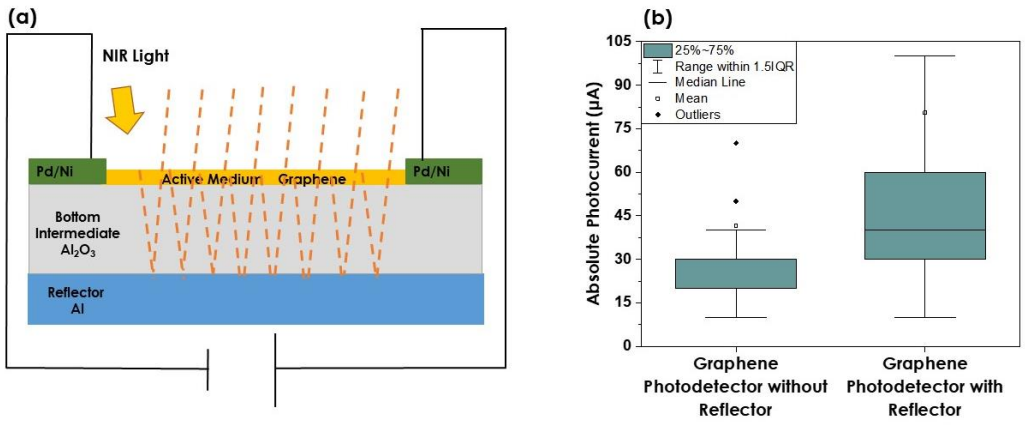

Figure 1: (a) Schematic side view of the fabricated graphene PDs, with an incoming beam experiencing multiple reflections (sketch). (b) Box plots of the absolute photocurrent of Graphene PDs with and without reflector (bias 100 mV). 30 PDs of each type were measured.