Photo-thermo-electric effect in scalable split-gate double-layer graphene photodetector

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Graphene is a promising material for photonic and optoelectronic applications [1], [2]. Its broadband operation and quick photo-response time make it a potential platform for many integrated photonic devices [1], [2], [3], [4]. We present a split-gate graphene photodetector fabricated on a Si_3N_4 waveguide exploiting the photo-thermo-electric (PTE) mechanism [5]. The device, shown in figure 1, comprises 2 layers of CVD single-crystal single layer graphene (SLG), utilised both as active channel and split gate. The two SLG are separated by a polymeric layer of poly(vinyl alcohol) (PVA) as gate dielectric. The materials employed in this device are compatible with large-scale integration. Using a spin-coated polymeric PVA dielectric allows us to preserve the SLG properties used for the photodetector channel. The field effect induced in the active channel by the split gates shows a very well-defined response with a sharp resistivity peak and a small shift of the charge neutrality point. The photovoltage map, presented in figure 2, shows a 6-fold pattern, a signature of PTE[6]. The maximum responsivity is 6 V/W. The detector shows a flat bandwidth up to 65 GHz, indicating much wider 3 dB bandwidth, with potential for high-speed applications.

References

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Figures

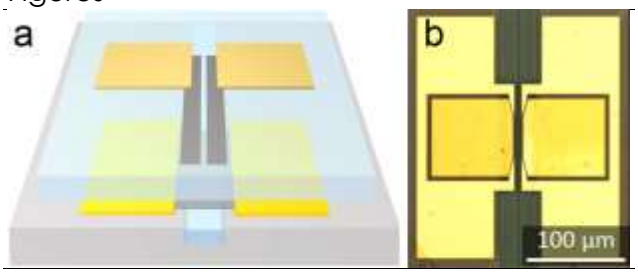

Figure 1: a) Schematic diagram of double-layer graphene photodetector. b) Optical micrograph of the completed device.

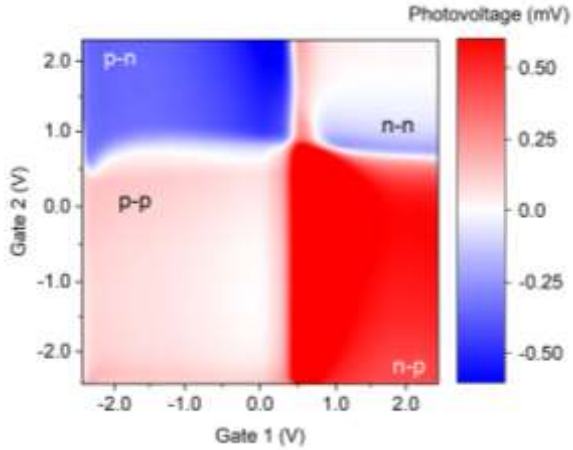

Figure 2: Photovoltage map as a function of split gate voltage, with 6-fold pattern

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