Hybrid Graphene/Silicon Schottky photodiode with intrinsic gating effect

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We characterized a hybrid device consisting of a graphene/silicon (Gr/Si) Schottky diode in parallel with a Gr/SiO2/Si capacitor for high-performance photodetection. The device, fabricated by transfer of commercial graphene on low-doped n-type Si substrate, achieves photoresponse as high as 3A/W and normalized detectivity higher than 3.5x10^{12}cmHz$^{1/2}$/W in the visible range. The device exhibits a photocurrent exceeding the forward current, as photo-generated minority carriers, accumulated at Si/SiO2 interface of the Gr/SiO2/Si capacitor, diffuse to the Gr/Si junction. We show that the same mechanism, when due to thermally generated carriers, although usually neglected or disregarded, causes the increased leakage often measured in Gr/Si heterojunctions. At room temperature, we measure a zero-bias Schottky barrier height of 0.52 eV, as well as an effective Richardson constant A**=4x10^{-5}Acm^{-2}K^{-2} and an ideality factor n≈3.6, explained by a thin (< 1nm) oxide layer at the Gr/Si interface.

References

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Figures

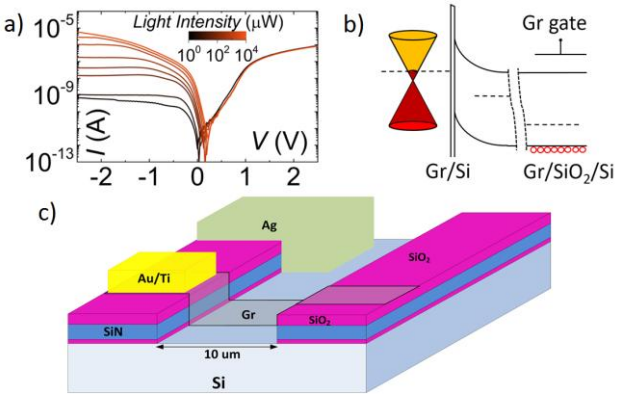

Figure 1: a) IV characteristics for different illumination level, b) band diagram in the Gr/n-Si and in the Gr/SiO_2/n-Si capacitor region, c) 3D schematic view of the device.