Supporting information

High Photocurrent in Gated Graphene-Silicon Hybrid Photodiodes

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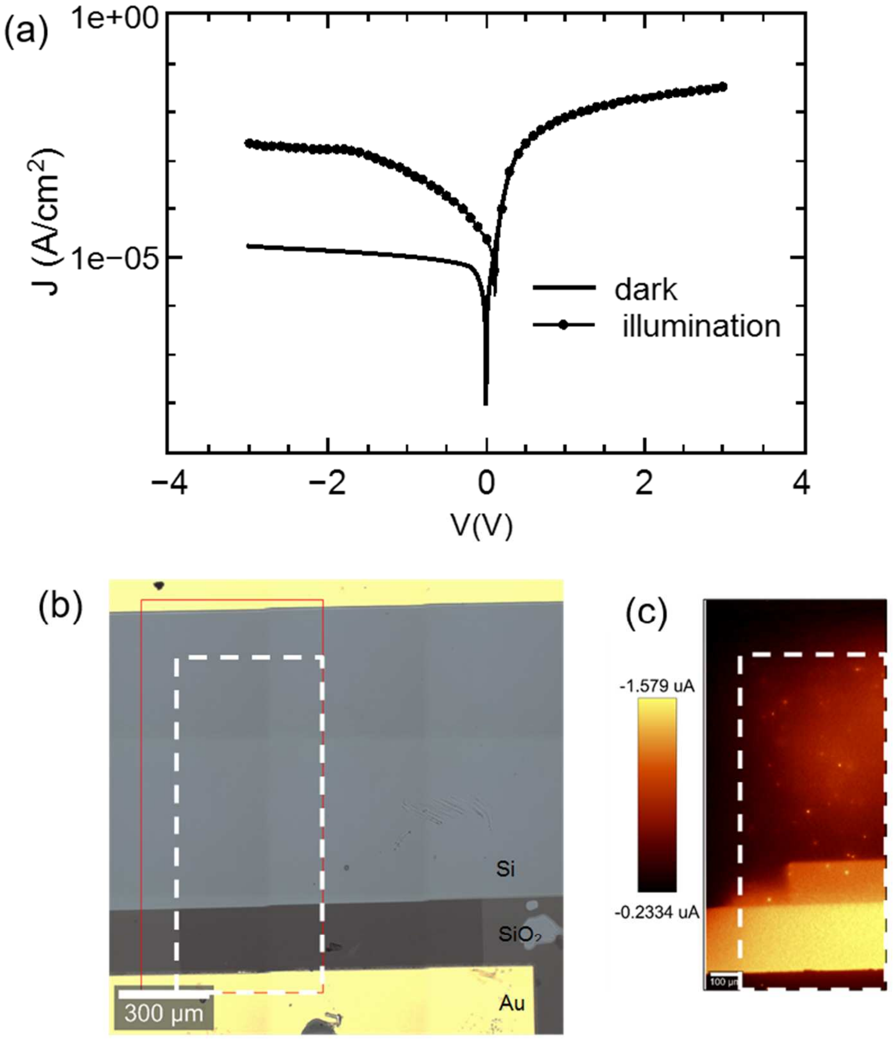

Fig. S1. (a) J-V plot of a graphene/n-Si photodiode with a large junction area in the dark and under white light illumination. Here, the oxide thickness was 85 nm. (b) Optical micrograph of the diode showing the regions of interest. Red rectangle depicts the scanned area where scanning photocurrent measurement was carried out while white dashed line shows the graphene region within the scanned area. (c) Current map of the area inside the red rectangle in (b) at a reverse bias of -2 V and at a laser power of 1 mW. The white dashed line shows the graphene region. It can be seen that the photocurrent is much higher in G/SiO$_2$/Si compared to that in G/Si region.

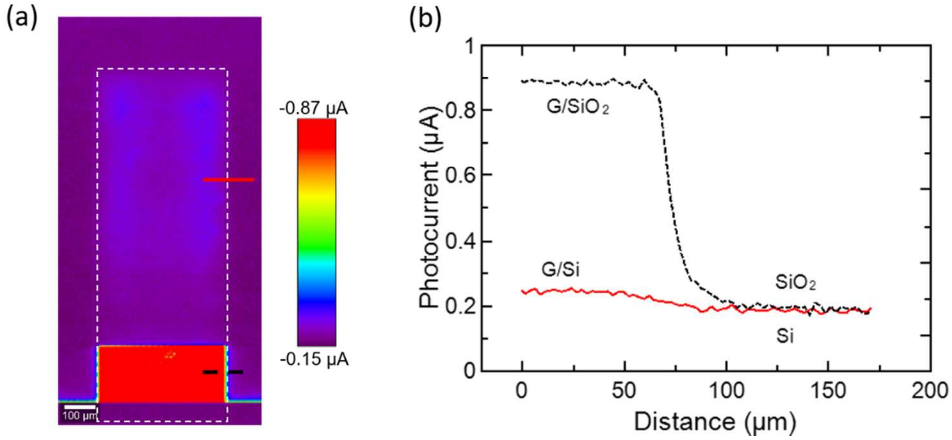

Fig. S2. (a) Photocurrent map of G/n-Si photodiode at a reverse bias of – 2 V and at incident laser power of 2 μW. White line depicts the area covered by graphene. (b) Line cross-section of photocurrent across G/SiO_2 (black dashed line) and G/Si (red solid line) junctions along the respective lines in (a). It can be clearly seen that photocurrent decays to a certain distance away from these junctions, indicating the diffusion of minority carriers.

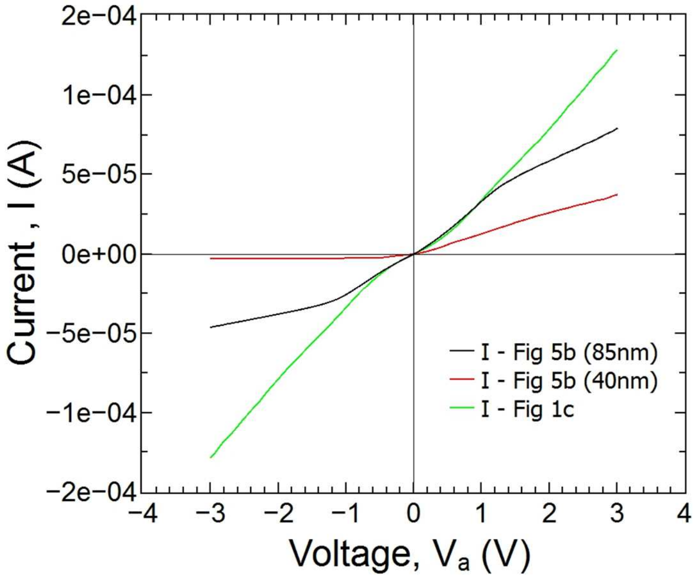

Fig. S3: I-V plot of the metal electrodes – n-Si substrate related to the devices represented in Fig 1c (green curve) and Fig 5b (red and black curves) of the manuscript.

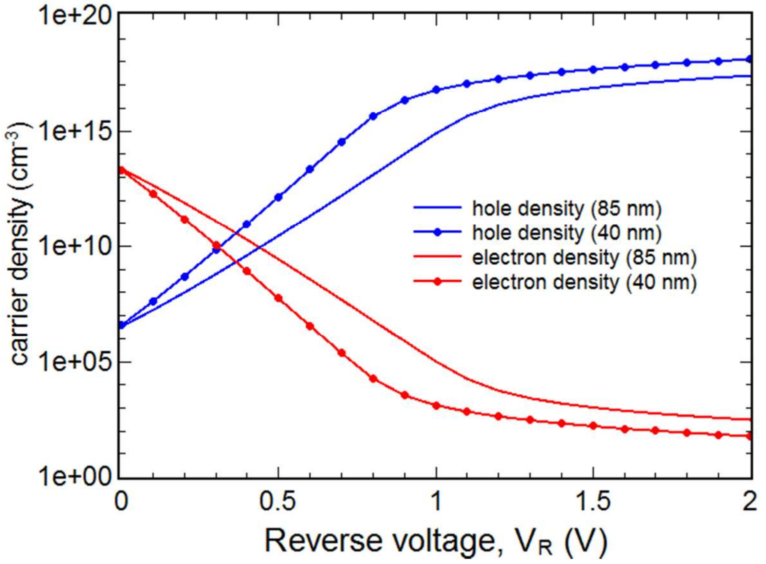

Fig. S4. Electron (red-line) and hole density (blue-line) as a function of the reverse voltage, V_R, for two oxide thickness, 40 nm (line+symbol) and 85 nm (line). A threshold voltage can be estimated around the V_R value where the change of slope, related to the creation of inversion layer, is noticeable. Also, a higher hole density is observed for 40 nm thick oxide pointing towards a stronger inversion layer compared to 85 nm thick oxide.