Supporting Information

Back-to-back MOS-Schottky (Pt-SiO_2-Si-C-Pt) nano hetero-junction device as an efficient self-powered photodetector: One step fabrication by pulsed laser deposition

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Carbon film prepared by pulsed laser deposition have been characterized by Raman spectroscopy,

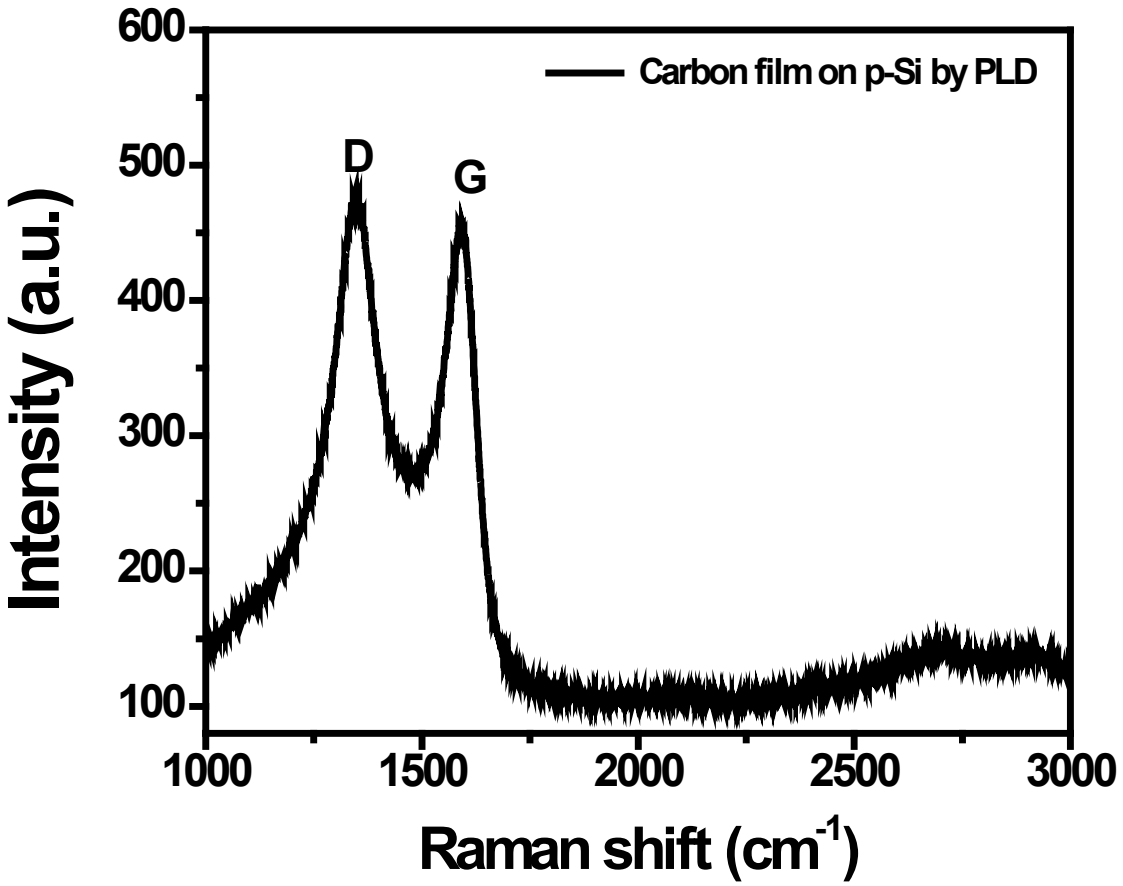

Figure S-1: Raman spectrum for carbon film prepared by PLD on p-Si substrate with 500 nm thickness.

In order to understand the reverse rectification I-V curves, a simple experiment was done and measurements were performed by keeping following electrode assembly.

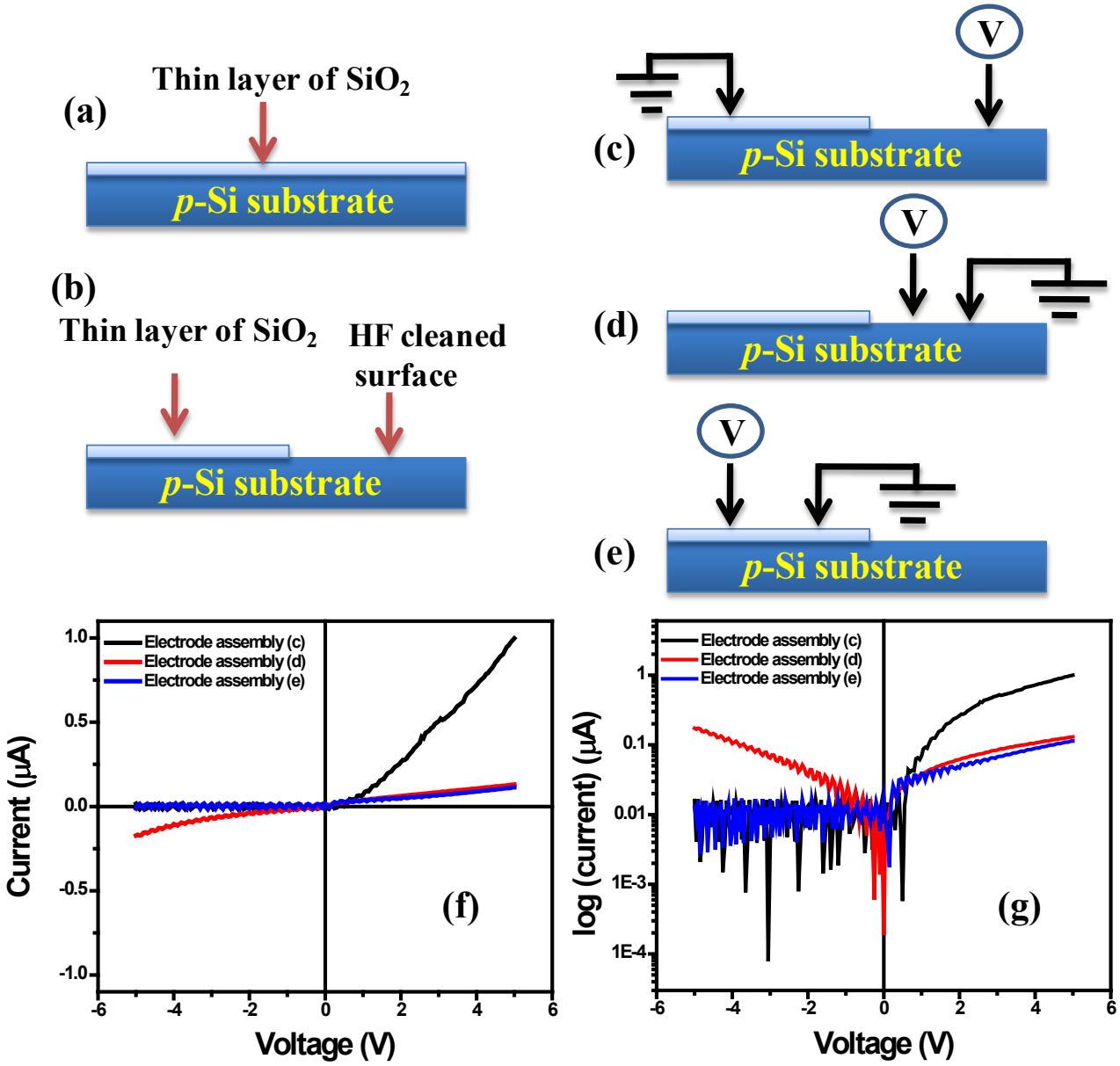

Figure S-2 (a) A thin layer of SiO_2 grown on *p*-Si substrate due to oxidation (b) Half part of substrate cleaned with HF, (c) one electrode was kept on HF cleaned surface and other on SiO_2 thin layer., (d) both electrode on HF cleaned surface, (e) Both electrode on thin layer of SiO_2 (f) I-V curves determined by keeping three different electrode assemblies. (g) I-v curves on semi-logarithmic curves.

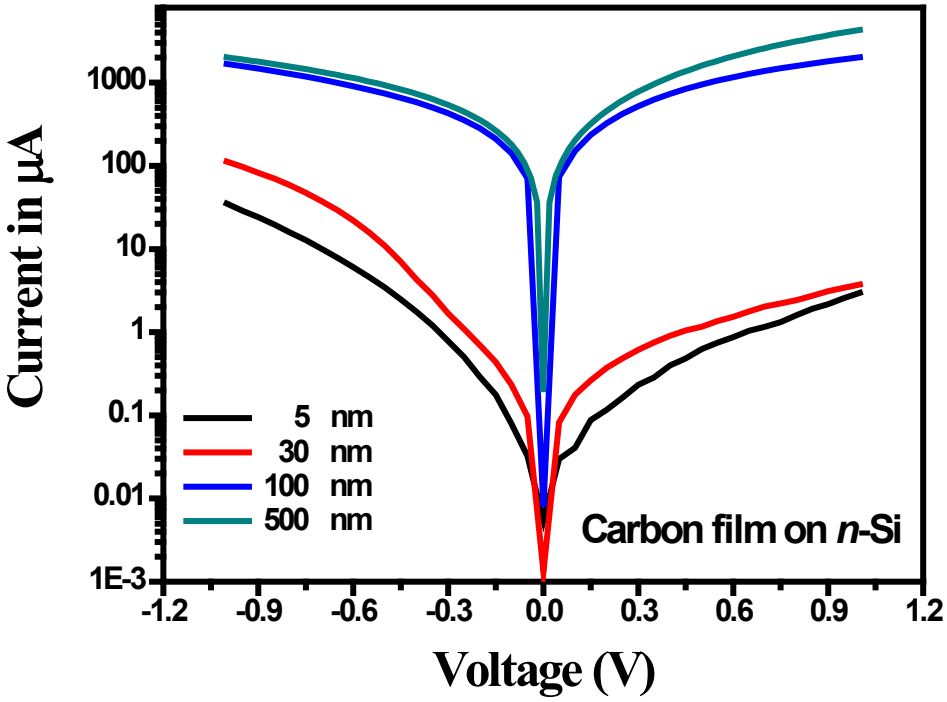

Figure S-3: Semi-log I-V plots for carbon film with different thickness on *n*-Si substrate.

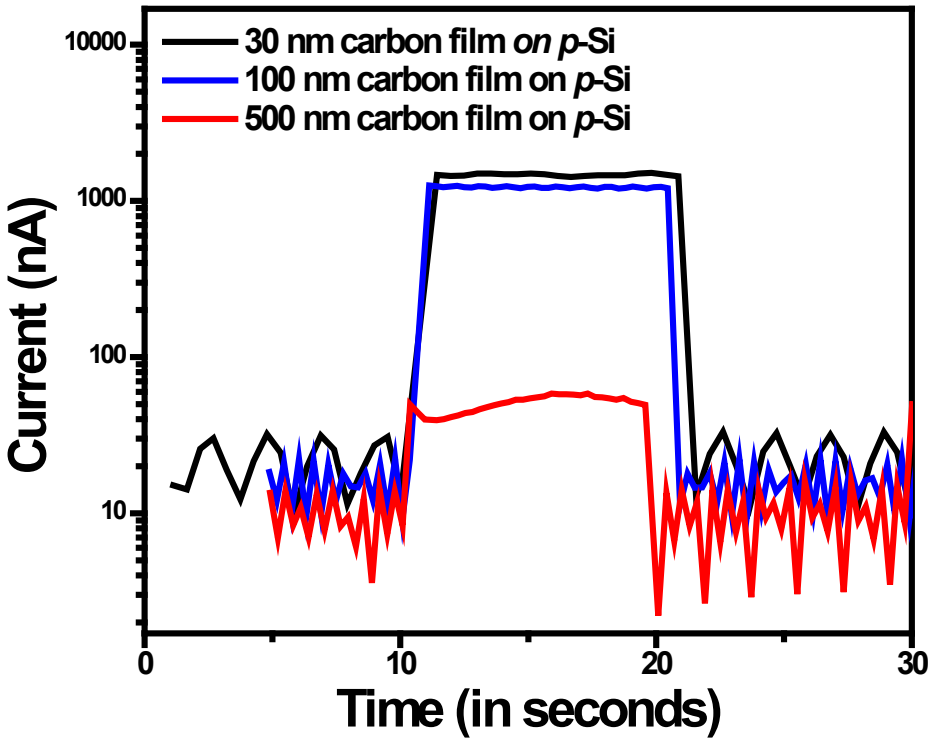

Figure S-4: Dynmic light responce under red LED illumination for carbon film with different thicknesses on *p*-Si substrate.

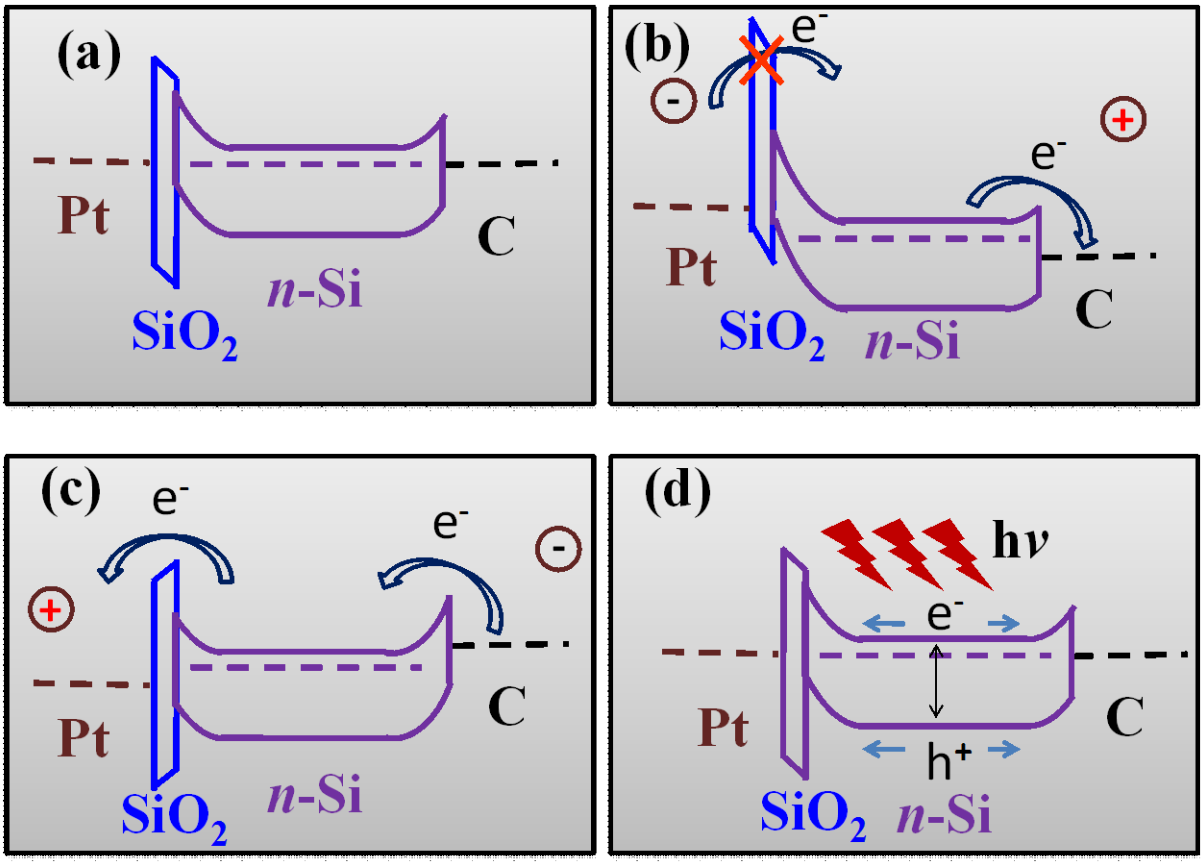

Figure S-5: Band alignment for platinum-silicon oxide- *n*-silicon -carbon case (a) at zero bias, (b) reverse bias, (c) forward bias and (d) under LED illumination at zero bias.

The resultant band alignment of *n*-Si with Pt and carbon at zero bias is shown in **figure S5 (a).** When this device arrangement is reverse biased i.e. positive polarity is applied to Carbon, the Fermi level of carbon shifts downwards while the Fermi of Pt shifts upward with respect to n-Si Fermi level (**figure S5 (b)**). Although the transfer of electrons from *n*-Si to carbon is possible here, the barrier created at Pt-SiO_2-Si junction restrains the transfer of electron from Pt to *n*-Si. When positive potential is applied to Pt, the device is now forward biased (**figure S5 (c)**). Then the Fermi energy of carbon shifts upward while the Fermi of Pt shifts downwards with respect to Fermi of *n*-Si. This situation is very much favorable for charge transfer across the interfaces, thereby resulting in substantial amount of current. When the device is illuminated by LED (**figure S5 (d)**), there is generation of electron – hole pairs in n-Si. However the band alignment does not allow efficient charge separation which results in no observable photocurrent.