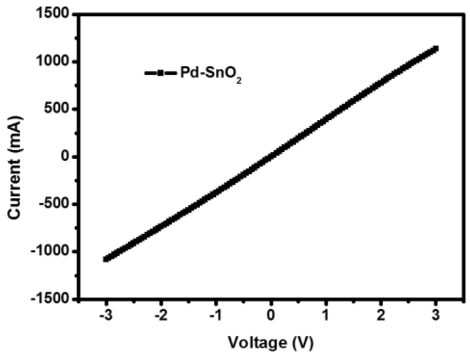

Fig. S1 The *I*-*V* curves of Pd-SnO_2.

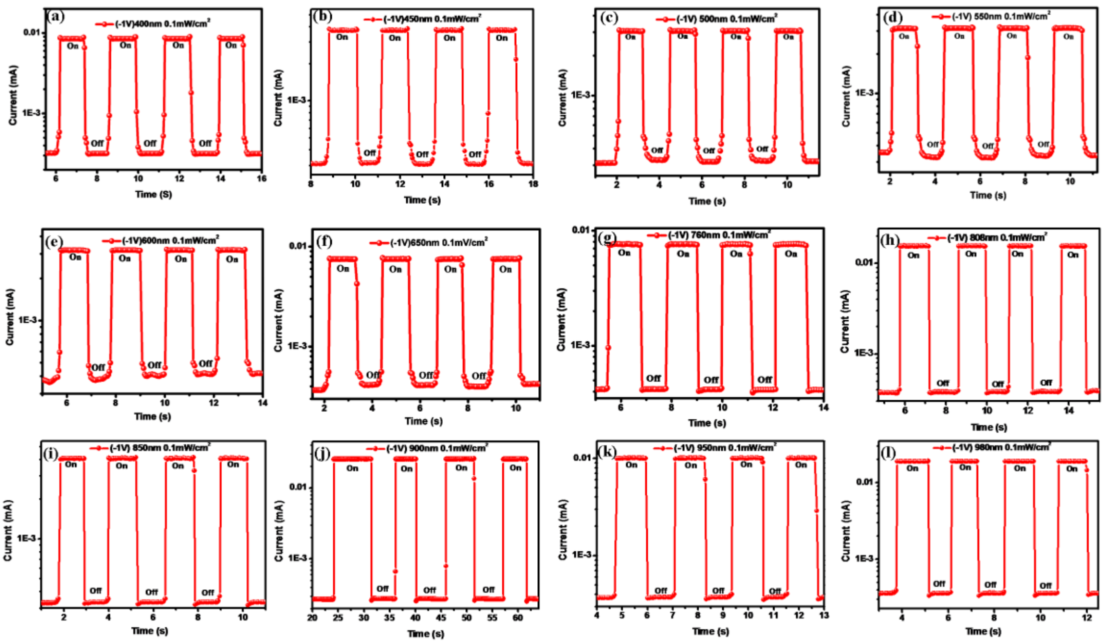

Fig. S2 (a-f) The photoresponse of SnO_2 nanoparticle thin film/SiO_2/*p*-Si heterojunctions at a bias of -1 V and different light wavelengths (400 nm, 450nm, 500 nm, 550nm, 600nm, 650 nm, 760nm, 808 nm, 850nm, 900 nm, 950nm, 980 nm).

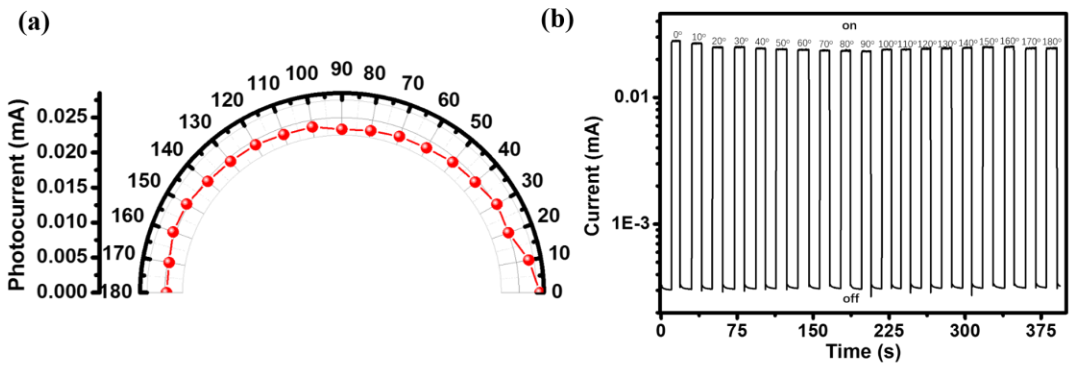

Fig. S3 (a) Polarization dependence of photocurrent; (b) photocurrent response of SnO_2 nanoparticle thin film/SiO_2/*p*-Si heterojunctions under incident light with different polarization angles. The 0° of polarization angle was defined as the any direction.

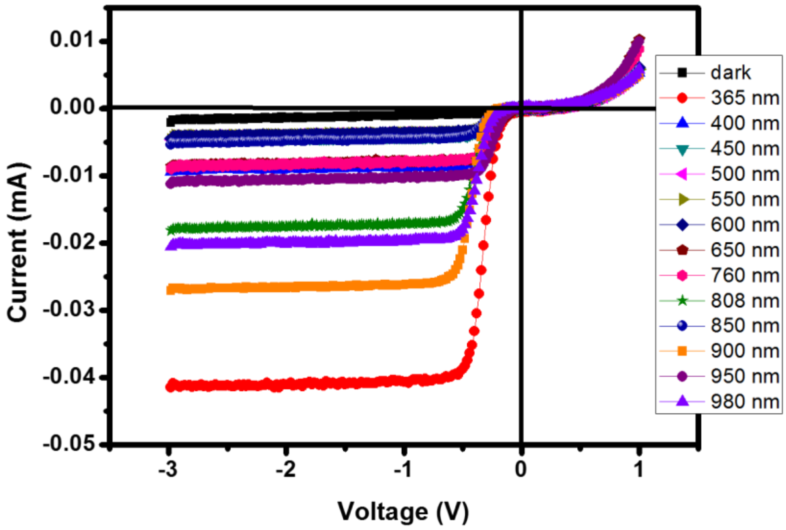

Fig. S4 The *I*-*V* curves of SnO_2 nanoparticle thin film/SiO_2/*p*-Si heterojunctions at different monochromatic lights (0.1 mW/cm^2) and dark.

The effect of an insulating SiO_2 layer on the photoresponse of heterojunction

An insulating SiO_2 layer between the SnO_2 and Si plays an important role in the photoresponse.[1,2] At present, it has been reported that adding the SiO_2 passivation layers can reduce the leakage current and make ZnO/*p*-Si heterojunction exhibit the enhanced on-off ratio.[3] It has been also demonstrated that the carrier multiplication process in the insulating oxide layer can improve the response of PDs. Moreover, it has been mentioned that in this work the thickness of natural SiO_2 layer on Si surface is only about 1.2 nm[4], which is accord with the optimized SiO_2 thickness (several nanometers) according to reported results.[5] The electric field in the SiO_2 layer is estimated to be 8.3×10^6 V/cm at 1 V bias using $E=V/d$, where E is the electric field, V is the bias voltage, and d is the thickness of the SiO_2 layers. Under the high intensity of the electric field the photo-generated carriers can tunnel through the SiO_2 layer. Meanwhile, it also is demonstrated that the thicker the SiO_2 layer is, the bigger the bias voltage is.[3] Therefore, the SiO_2 layer plays an important role in the photo-response and the operating bias voltage of SnO_2 nanoparticles thin film/SiO_2/*p*-Si heterojunction. The optimized SiO_2 thickness is several nanometers according to reported results.[5] If the SiO_2 layer is too thick, it can decrease the effectiveness of the carrier tunneling due to the scattering and trapping of the carriers in the SiO_2 layer, at the same time offers a high potential barrier preventing the carriers from the diffusion and shift tunneling the junction interface.[6] Thus, the photo-response of SnO_2/SiO_2/*p*-Si heterojunction would be degraded. At this moment, only a higher light power intensity and a greater bias voltage can remedy the negative impact produced by thicker SiO_2 layer. For example, in ZnO nanorods arrays/SiO_2/*p*-Si (lateral structure) the SiO_2 layer with about 50 nm make the operating bias voltage of detector be ~15 V.[3]

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