Supporting Information

High-performance Ultraviolet−to−Infrared Broadband Perovskite Photodetectors Achieved via Inter-/Intra-band Transitions

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S1. The device mechanism

The photo-detecting mechanism occurs as follows. When the incident light strikes the device surface and a negative bias is applied to the anode (ITO) and positive bias is applied to the cathode (the metal substrate), the photons will be absorbed by the material, forming an exciton. This exciton will be dissociated at the interface between the layers, creating electrons and holes (generated photocarriers). These electrons will travel along the electron transport layer (Gd-ZnO NRs) to be collected at the cathode. The same process applies to the hole carriers, which are collected at the anode.[1] Figure 1b (in manuscript) illustrates this mechanism. Thus, during light illumination, if positive bias is applied to the metal side (cathode) and negative bias is applied to ITO (anode), electrons and holes can travel and be collected at the metal side and the ITO side, respectively, due to a favorable barrier slope (a dark current in a positive voltage depicted in Fig. 5a), as shown in Figure 1b (in manuscript). Hence, the use of Gd-doped ZnO NRs in this vertical device structure can facilitate electron transport and block hole transport into the metal side, resulting in a much higher photocurrent (including injection current). However, if positive bias is applied to the ITO side (anode), as the transport of electrons and holes is limited by energy barriers, the current will be small (i.e. a dark current of a negative voltage shown in Fig. 5a).

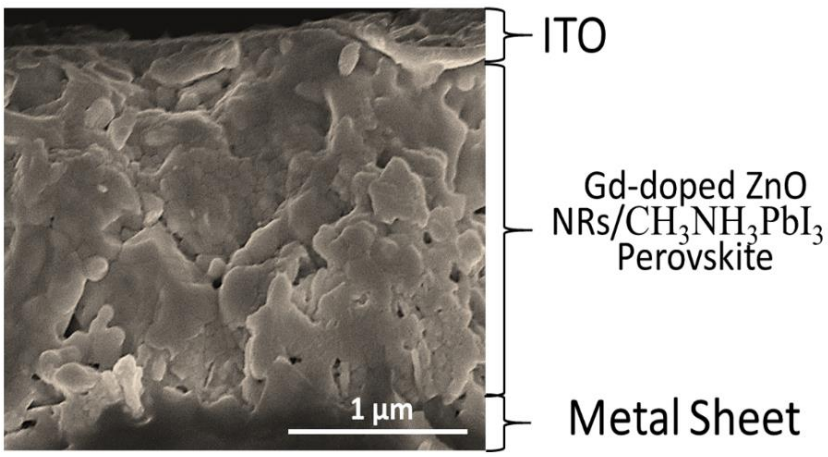

Figure S1. Cross-sectional SEM images Gd-doped ZnO NRs/$CH_3NH_3PbI_3$/ITO fabricated on 316L stainless steel.

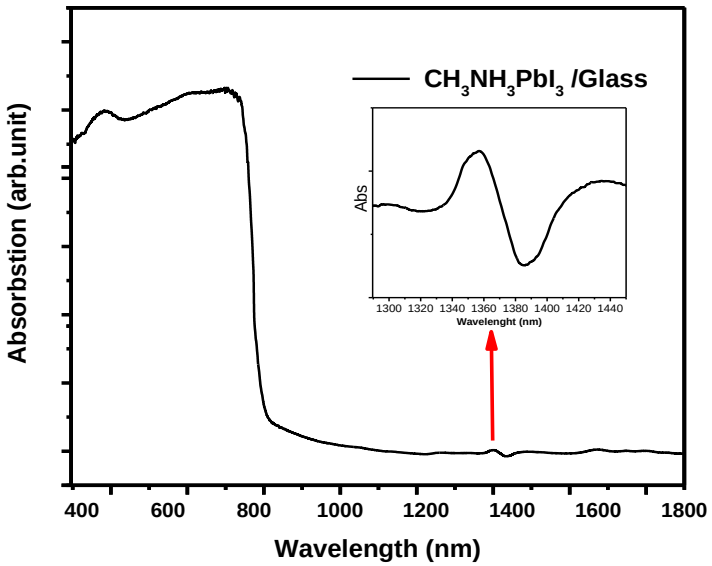

Figure S2. The absorption spectra of $CH_3NH_3PbI_3$ perovskite on glass substrate.

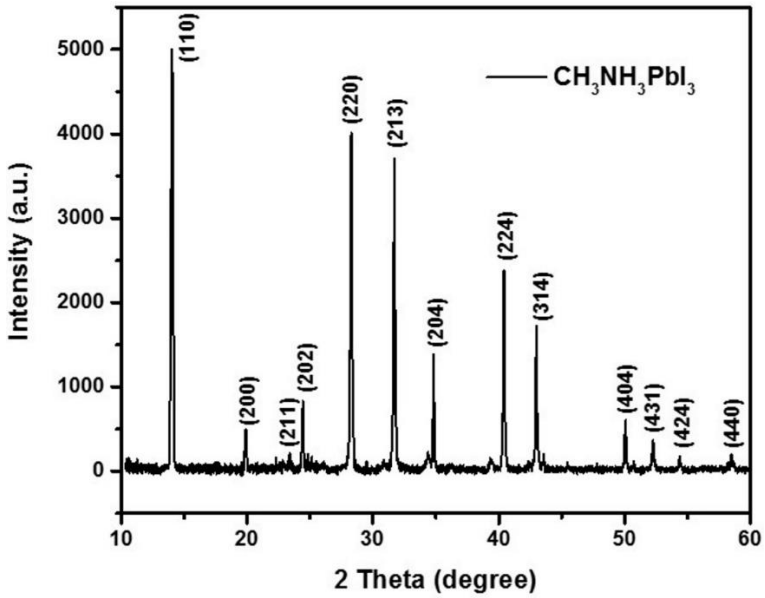

Figure S3. XRD pattern of $CH_3NH_3PbI_3$ perovskite on glass substrate**.**

References:

1- Williams, G.; Backhouse, C. Aziz, H., Integration of Organic Light Emitting Diodes and Organic Photodetectors for Lab-on-a-Chip Bio-Detection Systems. Electronics 2014, 3, 43-75.