Supporting Information

Perovskite/porous GaN crystal hybrid structure for ultrahigh sensitivity ultraviolet Photodetectors

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This file includes:

S1. Materials

Acquisition of chemical reagents：acetone (C_3H_6O, 99%, Sinopharm Chemical Reagent Co., Ltd, Suzhou, China), avantin ($(CH_3)_2CHOH$, 99%, Sinopharm Chemical Reagent Co., Ltd, Suzhou, China), lead bromide ($PbBr_2$, 99.999%, Optimal New Energy Technology Co., Ltd, Yingkou, China), ammonium methyl bromide ($CH_3NH_3PbBr_3$, Optimal New Energy Technology Co., Ltd, Yingkou, China), dimethyl formamide (DMF, Optimal New Energy Technology Co., Ltd, Yingkou, China), dimethyl sulphoxide (DMSO, Optimal New Energy Technology Co., Ltd, Yingkou, China), chlorobenzene(C_6H_5Cl,Optimal New Energy Technology Co., Ltd, Yingkou, China).

S2. Characterization Methods

The contact angle was measured by a surface tension measuring instrument named OSA200-T. Scanning electron microscopy (SEM) images were taken with a Hitachi S-4800 field emission microscope equipped with a Horiba EX-450 energydispersive X-ray spectroscopy (EDS) attachment. Raman spectra of samples were obtained with a LabRAM HR system of Horiba Jobin Yvon at room temperature and using a 532 nm solid state laser as the excitation source. XRD was collected by a Bruker D8 Advance X-ray diffractometer with Cu Kα radiation (λ = 1.5406 Å).

Photoluminescence (PL) measurement was carried out at room temperature using 325 nm He–Cd lasers as the excitation source.

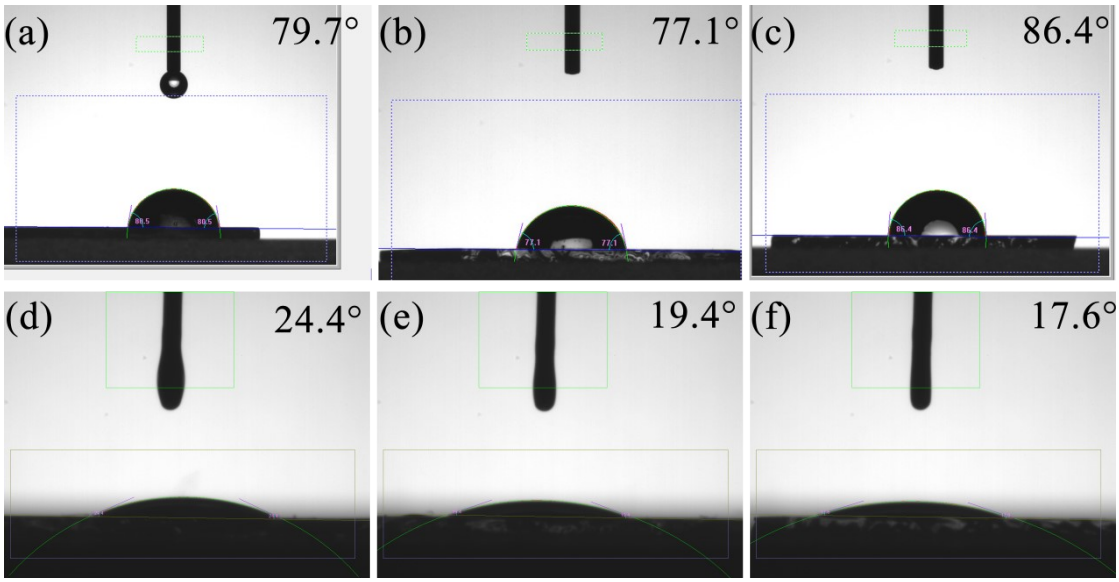

Fig. S1 Before oxygen plasma cleaning water contact Angle measurement for *n*-GaN template with different pore sizes: (a) planar, (b) 200nm, (c) 1000nm. After oxygen plasma cleaning, water contact angle measurement for *n*-GaN template with different pore sizes: (d) planar, (e) 200nm, (f) 1000nm.

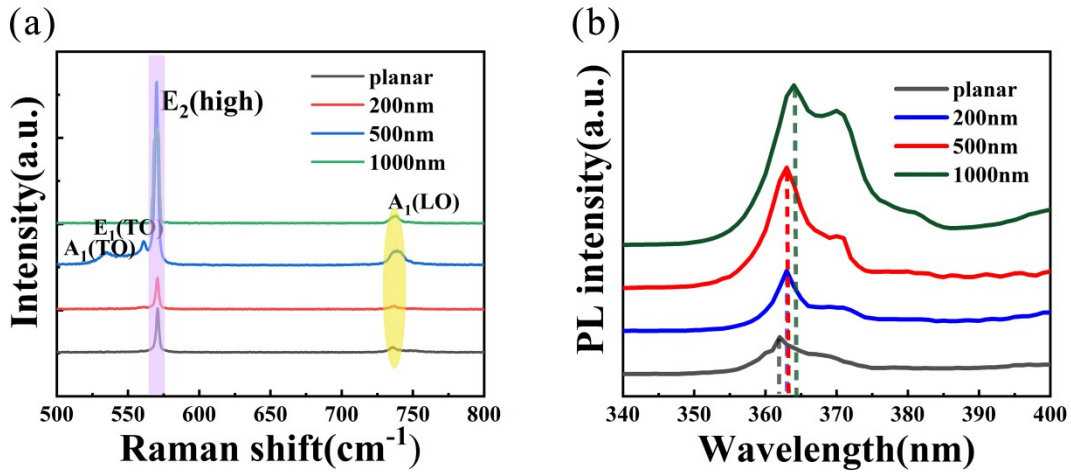

Fig. S2 (a) PL spectra and (b) Raman spectra of n-GaN films with different pore sizes.

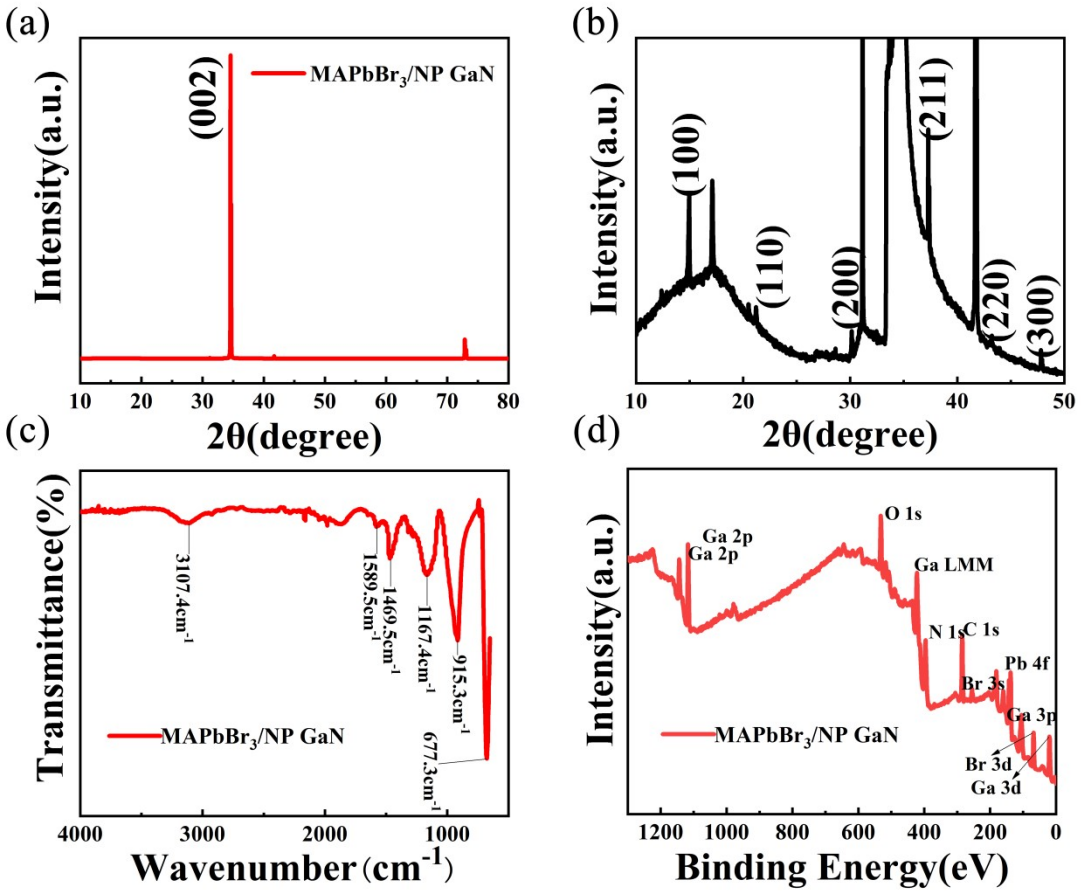

Fig. S3 (a-b) XRD patterns of $MAPbBr_3$/NP GaN hybrid samples. **Figure S3b** is a partial enlargement of **Figure S3a**. (c) FTIR patterns of $MAPbBr_3$/NP GaN hybrid samples. (d) XPS patterns of $MAPbBr_3$/NP GaN hybrid samples.

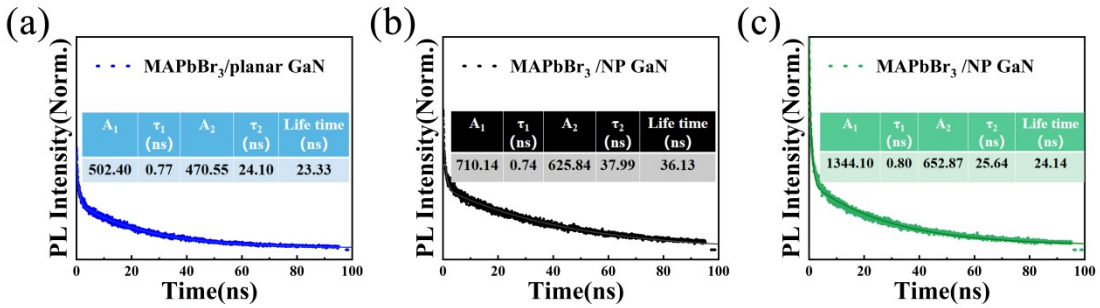

Fig. S4 Normalized transient PL decay profile of $MAPbBr_3$/NP GaN hybrid samples, wherein the pore size of GaN is (a) planar, (b) 200nm, (c) 1000nm.

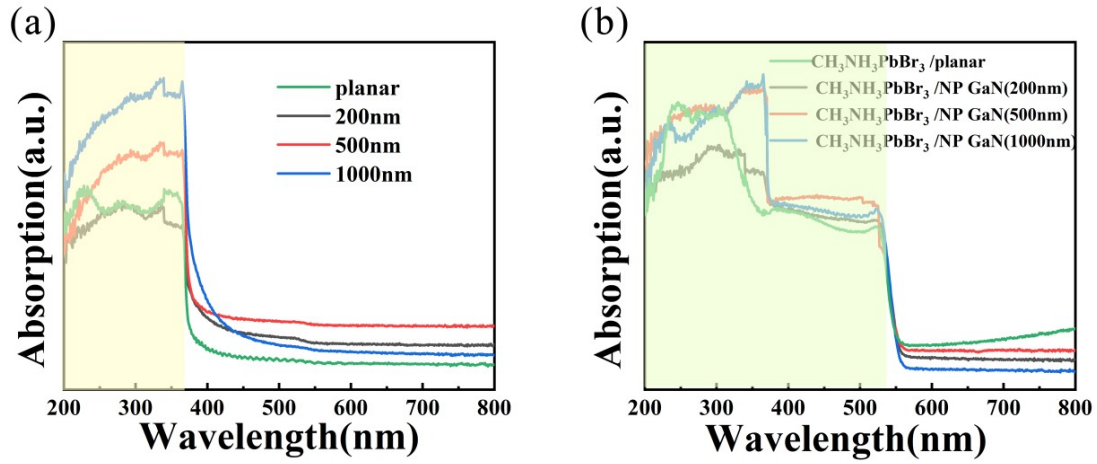

Fig. S5 Ultraviolet absorption spectra of (a) NP GaN templates and (b) $MAPbBr_3$/NP GaN hybrid samples.

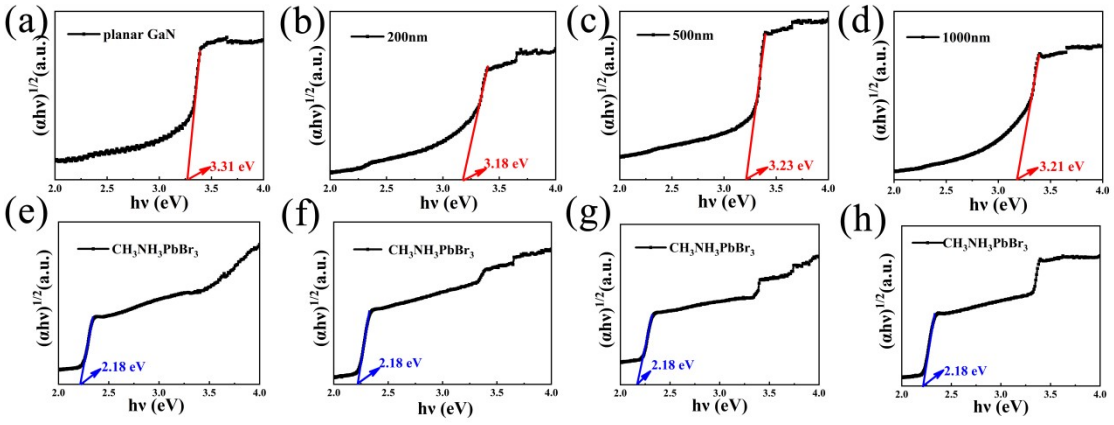

Fig. S6 UV absorption spectra of *n*-GaN templates with different pore sizes: (a) planar, (b) 200nm, (c) 500nm, (d) 1000nm. UV absorption spectra of $MAPbBr_3$ on GaN templates with different pore sizes: (e) planar, (f) 200nm, (g) 500nm, (h) 1000nm.

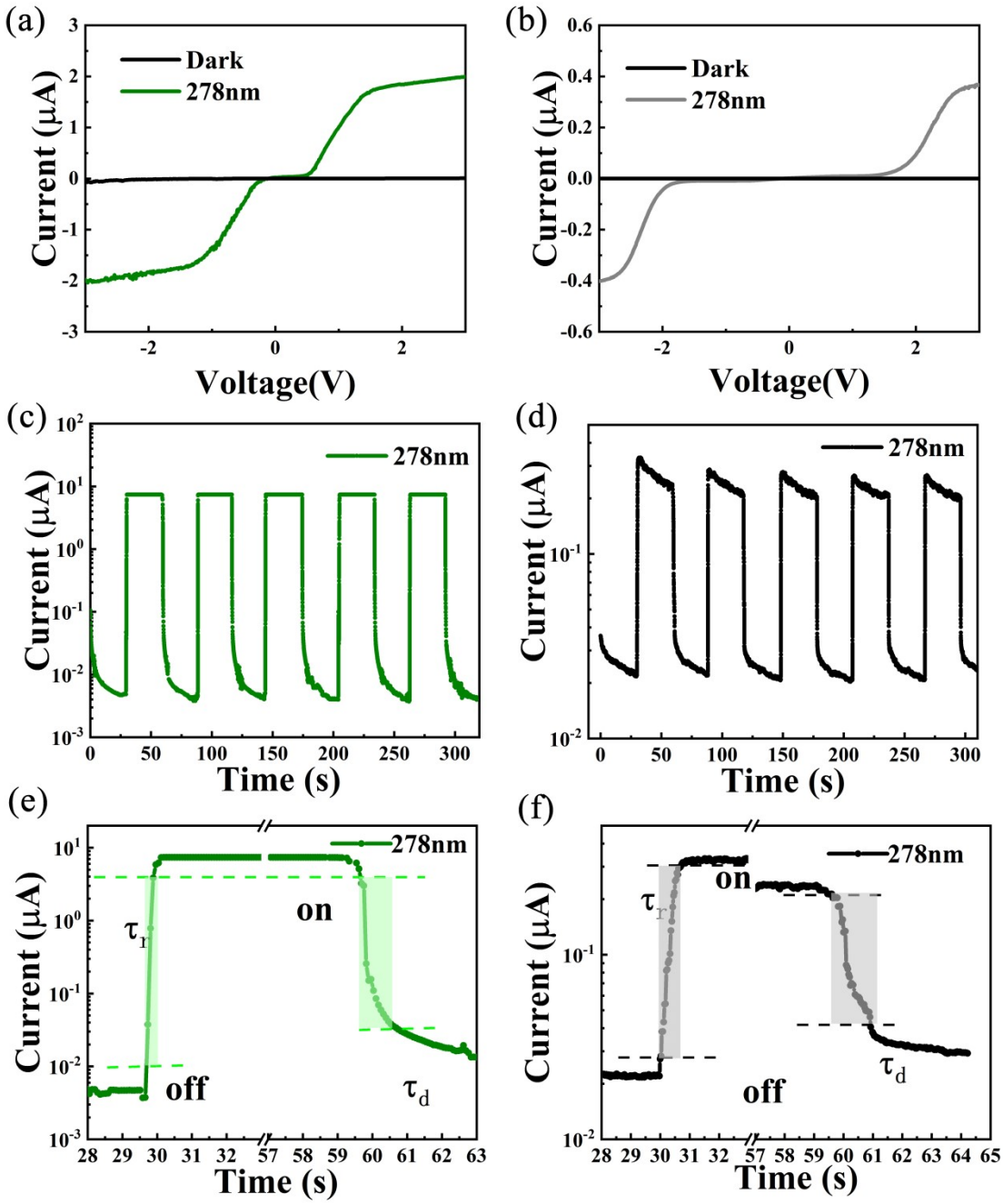

Fig. S7 I–V curves of (a) $MAPbBr_3$/NP GaN heterojunction PD and (b) NP GaN PD under 278nm light illumination. I–T curves of (c) $MAPbBr_3$/NP GaN heterojunction PD and (d) NP GaN PD under 278nm light illumination. Enlarge view of the current rise and decay process for (e) $MAPbBr_3$/NP GaN heterojunction PD and (f) NP GaN PD under 278nm light illumination. wherein the pore size of GaN is about 500nm.

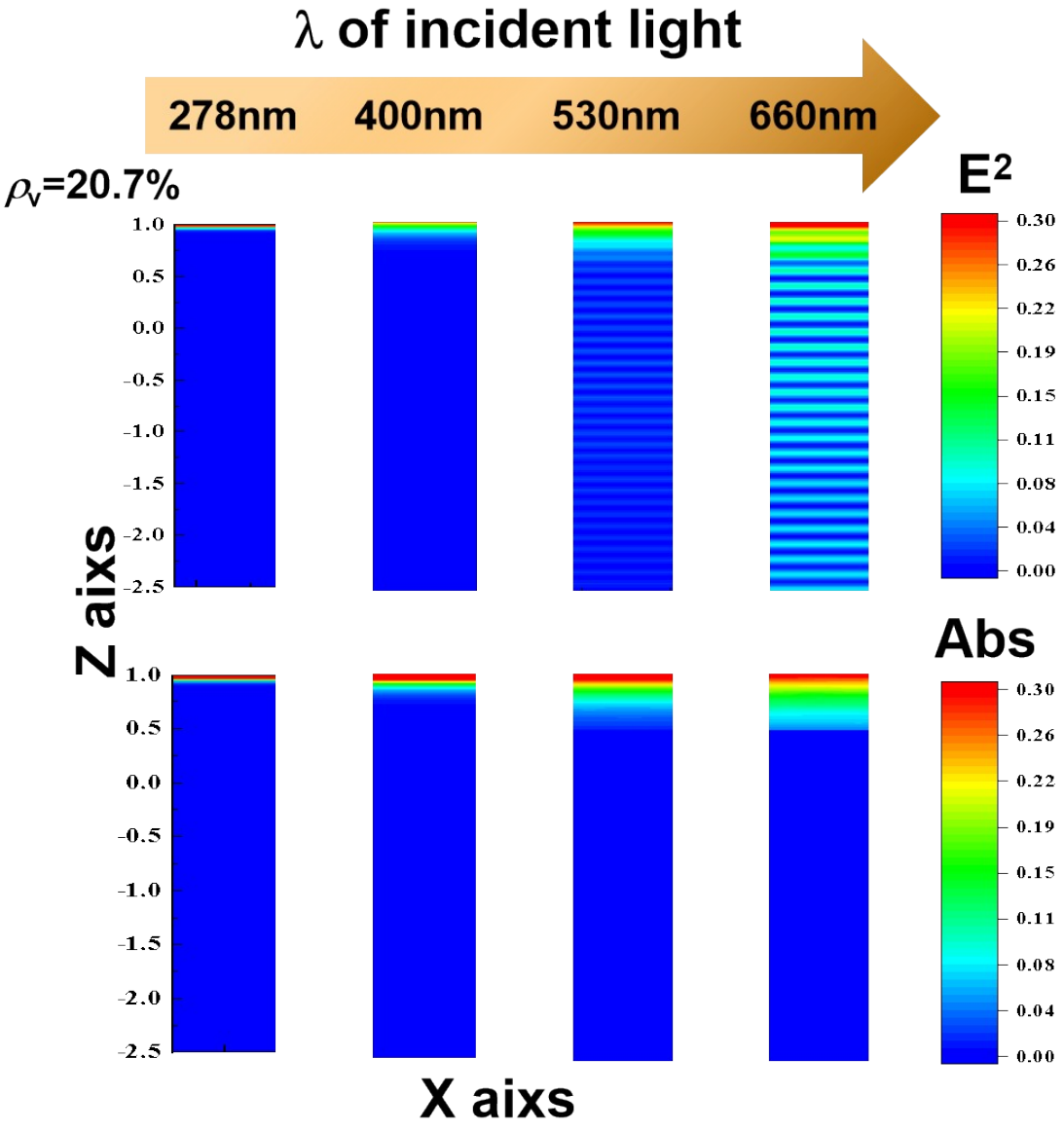

Fig. S8 The square of the total amplitude of the electric field (E^2) and the absorption intensity (Abs) for $MAPbBr_3$/NP GaN hybrid samples with UV incident light (λ = 278, 400, 530 and 660 nm). The pore size of GaN is about 1000nm and the pore density is 20.7%.

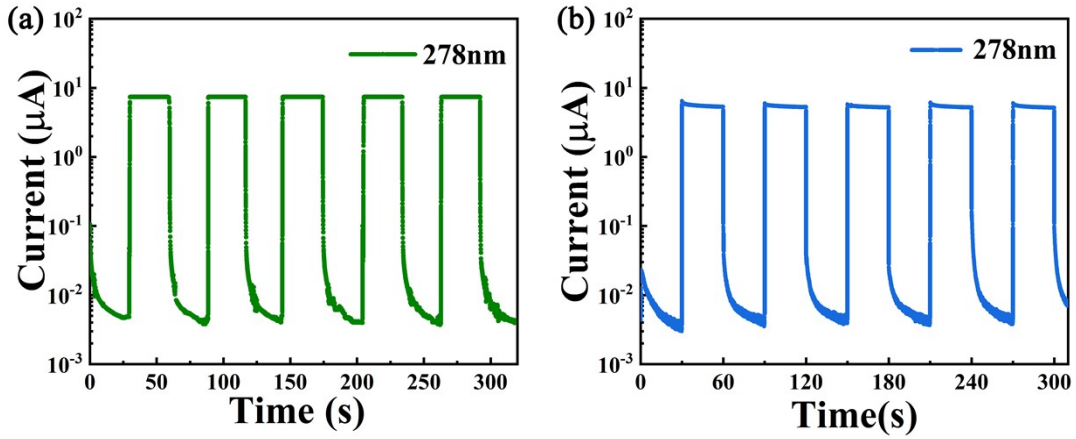

Fig. S9 Time response (I–T curve) of the $MAPbBr_3$/NP GaN hybrid structure PD (a) at day one

and (b) after 3 months under 278 nm light illumination.