Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Piezo-phototronic effect modulated performances in guest-substrate integrated p-i-n GaN ultraviolet detector

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Figure Caption

Figure S1. Schematic diagram of the calculation of strain

Figure S2. Electrochemical etching process. (a) Schematic diagram of electrochemical etching device. (b) Schematic diagram of the structure of the fabricated p-i-n GaN UV photodiode.

Figure S3. The PL spectra of the as grown p-i-n GaN membrane.

Figure S4. Photo response performance of the p-i-n GaN UV photodiode illuminated by 325 nm lasing with power density of 2.5 mW/cm^2. (a) The rise time and (b) decline time of the p-i-n GaN UV photodiode at the bias of 0 V. (c) The response time of the p-i-n GaN UV photodiode at -2 V bias voltage. (d) Photocurrent, *R*, and *D* as a function of the illumination power density at -2 V bias voltage, respectively.

Figure S5. Energy band diagram for illustrating the effects of the applied voltage under 325 nm illumination at strain-free condition.

Note 1. Calculation of the strain stored in the bent p-i-n GaN UV photodiode[1].

The key parameters easily measured about the calculation of the strain are illustrated in **Figure S1**, which can be readily measured experimentally. Because the size of the p-i-n GaN UV photodiode is smaller than those of the flexible mica, the mechanical behavior of the substrate and device is not affected by the GaN, assume the mica was bent with a radius of R and arc length of S. The thickness of the mica substrate is h, and its corresponding angle θ. Where l is the distance between the A and B. Therefore, the strain of the bent p-i-n GaN UV photodiode can be mathematically described by the following equations:

$$S = 2R * \theta \tag{1}$$

$$L = 2R * sin(\frac{\theta}{2}) \tag{2}$$

$$R * sin(\frac{S}{2}/R) - \frac{l}{2} = 0 \tag{3}$$

$$R = r + \frac{h}{2} \tag{4}$$

$$\varepsilon = \frac{h}{2(r + \frac{h}{2})} \tag{5}$$

Figure S1.

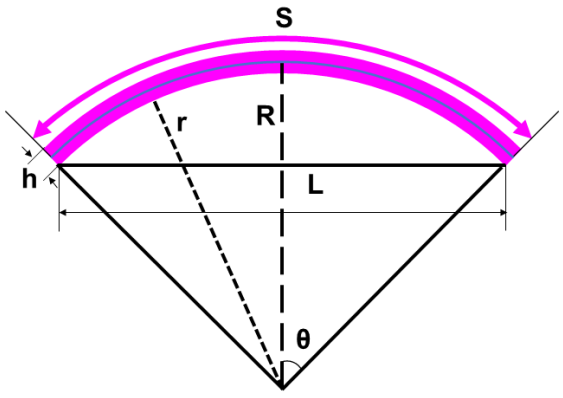

Figure S1. Schematic diagram of the calculation of strain

References:

L. Chen，K. Zhang，J. Dong，B. Wang，L. He，Q. Wang，M. He，X. Wang, Nano Energy 2020, 72, 104660.

Figure S2.

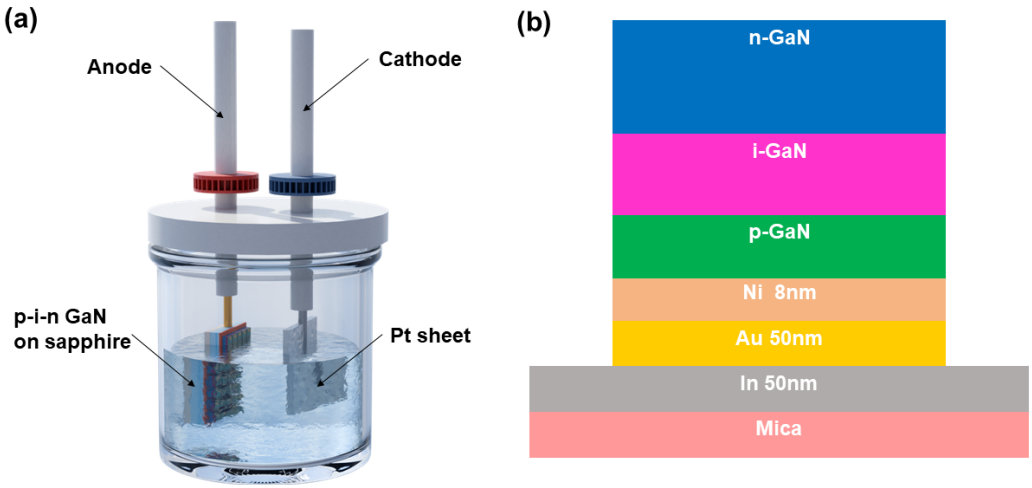

Figure S2. Electrochemical etching process. (a) Schematic diagram of electrochemical etching device. (b) Schematic diagram of the structure of the fabricated p-i-n GaN UV photodiode.

Figure S3.

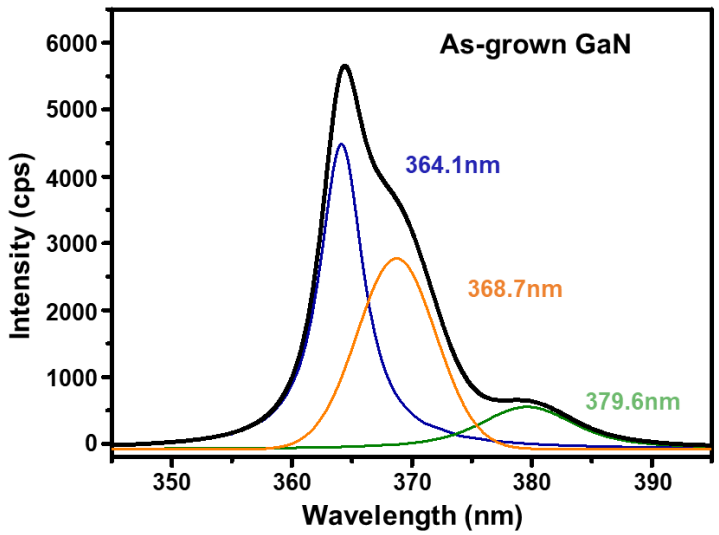

Figure S3. The PL spectra of the as grown p-i-n GaN membrane.

Figure S4.

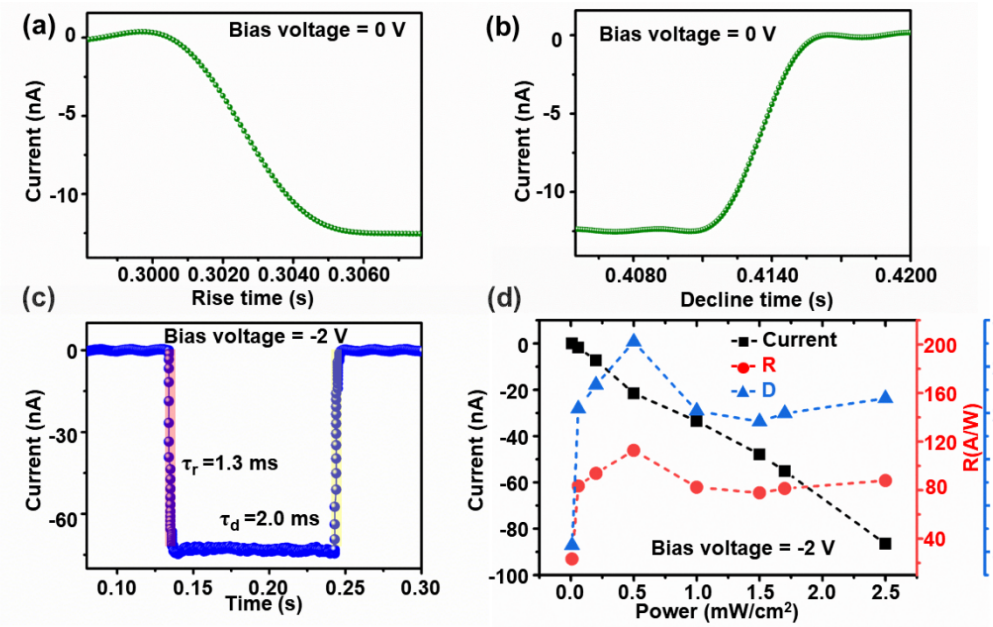

Figure S4. Photo response performance of the p-i-n GaN UV photodiode illuminated by 325 nm lasing with power density of 2.5 mW/cm^2. (a) The rise time and (b) decline time of the p-i-n GaN UV photodiode at the bias of 0 V. (c) The response time of the UV photodiode at -2 V bias voltage. (d) Photocurrent, *R*, and *D* as a function of the illumination power density at -2 V bias voltage, respectively.

Figure S5.

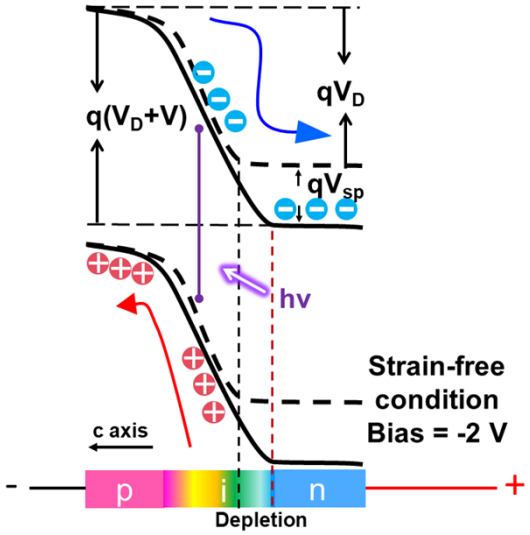

Figure S5. Energy band diagram for illustrating the effects of the applied reverse bias

voltage under 325 nm illumination at strain-free condition.