Supplementary data

Tailoring photodetection performance of self-powered Ga_2O_3 UV solar-blind photodetectors through asymmetric electrodes

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1. Transient photo-response of the self-powered UV photodetectors kept in the atmosphere for two months.

Fig. S1. Transient response of the amorphous Ga$_2$O$_3$ thin film photodetectors measured after placed in an atmospheric environment for two months (a) Asymmetric-electrode-size photodetector Au/Ti/Ga$_2$O$_3$/Ti/Au and Asymmetric-electrode-material photodetector (b) Au/Ti/Ga$_2$O$_3$/GZO (c) Au/Ti/Ga$_2$O$_3$/Au

The self-powered photodetectors were kept in the atmosphere. Fig. S1 shows the transient response performances of the amorphous Ga$_2$O$_3$ thin film photodetectors exposed to the atmosphere for two months. The current increased and decreased with the light turn on and off. It shows that these detectors have high-stability and high-repeatability of detection performances. All the self-powered detectors fabricated in this work show a promising potential to be applied in the long-time working applications in the harsh environment.
2. Calculation of the Schottky barrier heights of an asymmetric-electrode-size photodetector between electrodes and Ga$_2$O$_3$ thin films.

Fig. S2. The fitting of the linear region of the ln($J$)−$V$ characteristics for an asymmetric-electrode-size photodetector. (a) Reverse voltage; (b) Forward voltage

The two-side Schottky barrier height of an asymmetric-electrode-size photodetector can be calculated as

$$ J_s = A^*T^2 \exp(-q\Phi_B/kT) $$

where $J_s$ is the saturation current density of the device, $k$ is Boltzmann’s constant, $T$ is the evaluated temperature, and $e$ is the electron charge. The ln$J_s$ can be obtained through the intercept of tangent line of each ln$J$-$V$ curve, as shown in Fig. S2. Based on the Eq. (1), the $q\Phi_{BH} = (k_BT)[\ln T^2A^* - \ln J_s]$. Thus, the $q\Phi_{BH}$ of Ga$_2$O$_3$ with left and right electrodes are calculated as values of 0.880 eV and 0.879 eV, respectively, indicating the heights of the Schottky barrier on both sides are almost equal.
3. Calculation of the Schottky barrier heights of asymmetric-electrode-material photodetectors between two-side metal electrode and Ga$_2$O$_3$ thin film.

Based on the Eq. (1), the $q\Phi_{B1}$ between the Ga$_2$O$_3$ and the Au/Ti, the $q\Phi_{B2}$ between the Ga$_2$O$_3$ and the GZO, and the $q\Phi_{B3}$ between the Ga$_2$O$_3$ and the Au are calculated as values of 0.880 eV, 0.863 eV and 0.898 eV, respectively.