Supporting Information

A simple, repeatable and highly stable self-powered solar-blind photoelectrochemical-type photodetector using amorphous Ga_2O_3 films grown on 3D carbon fiber paper

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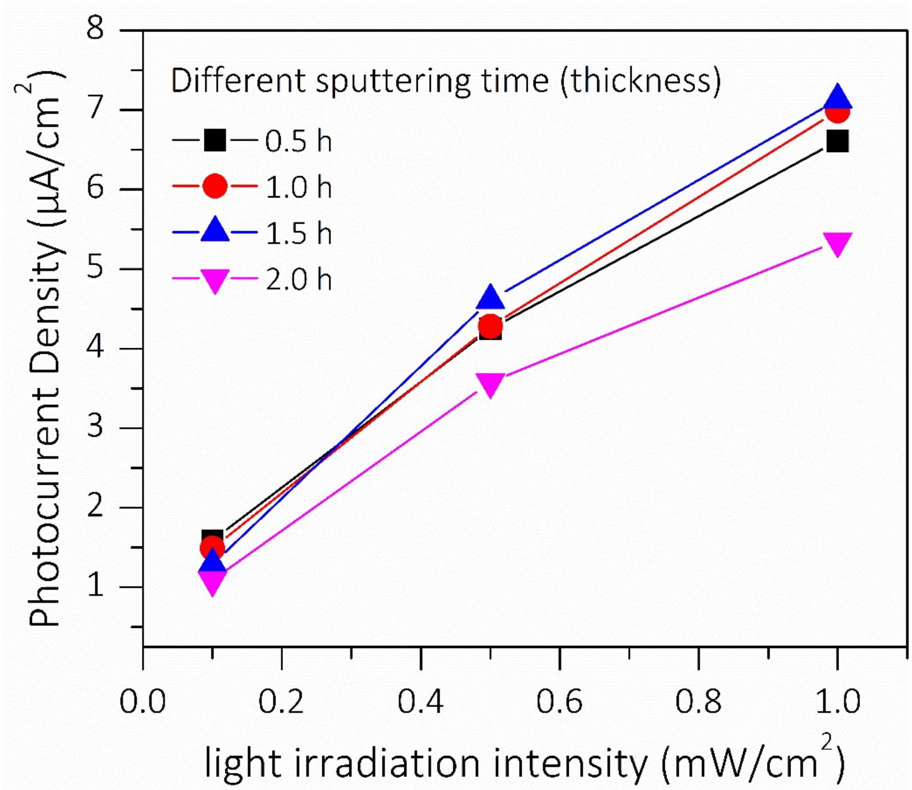

Fig. S1. photocurrent density (I_{photo}) of a-Ga_2O_3/CFP PEC-PDs with different sputtering time under different 254 nm light intensities. ***It is worth noting that*** photocurrent density (I_{photo}) was calculated as follows: $I_{photo} = I_{light} - I_{dark}$, where I_{light} and I_{dark} are defined as the current density with or without irradiation.

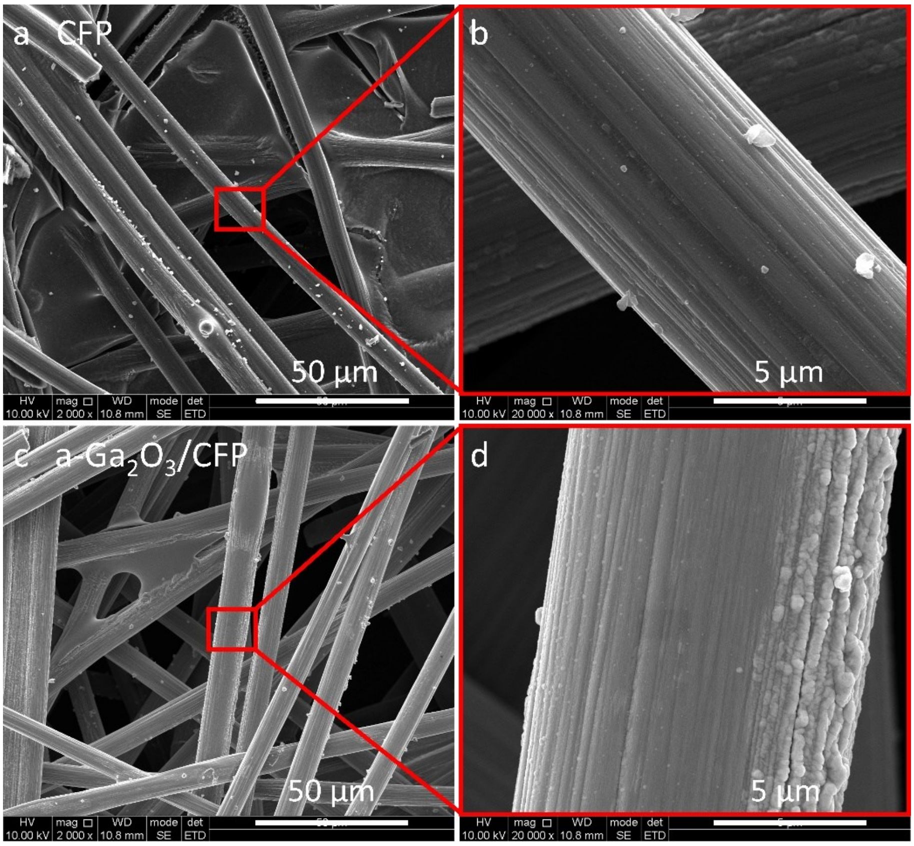

Fig. S2. SEM morphologies of (a-b) CFP and (c-d) *a*-Ga_2O_3/CFP photoelectrode. As seen, the CFP is composed of smooth carbon fiber rods with a diameter of ~ 10 μm in staggered stack arrangement. After sputtering *a*-Ga_2O_3, the metallic luster of CFP disappears, and the surface of the carbon fiber rods is no longer smooth. Moreover, the *a*-Ga_2O_3 is well wrapped on the CFP, at least for the most part, forming a similar *a*-Ga_2O_3/CFP core-shell structure.

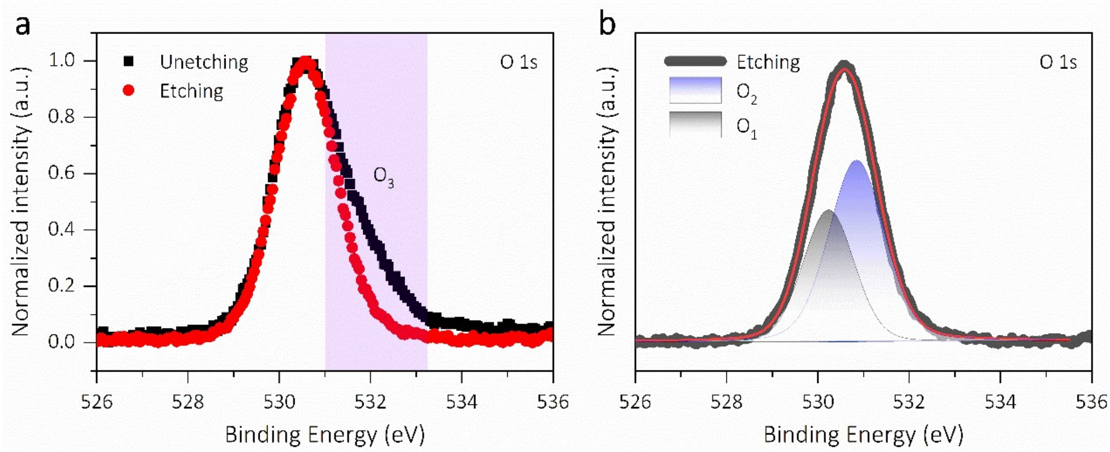

Fig. S3. (a) The O 1s core level spectrum of the unetched and etched *a*-Ga_2O_3. The etching time is 60 s. It can be seen from the figure that the O_3 (532.0 eV) peak disappeared after etching, indicating that the chemisorbed species on the surface of *a*-Ga_2O_3 was etched away. (b) The O 1s core level spectrum of the etched *a*-Ga_2O_3. Obviously, O1s core level spectrum can be divided into two peaks, corresponding to O_1 and O_2, demonstrating that the etched *a*-Ga_2O_3 still contains a relatively high concentration of oxygen vacancy (V_O) defects.

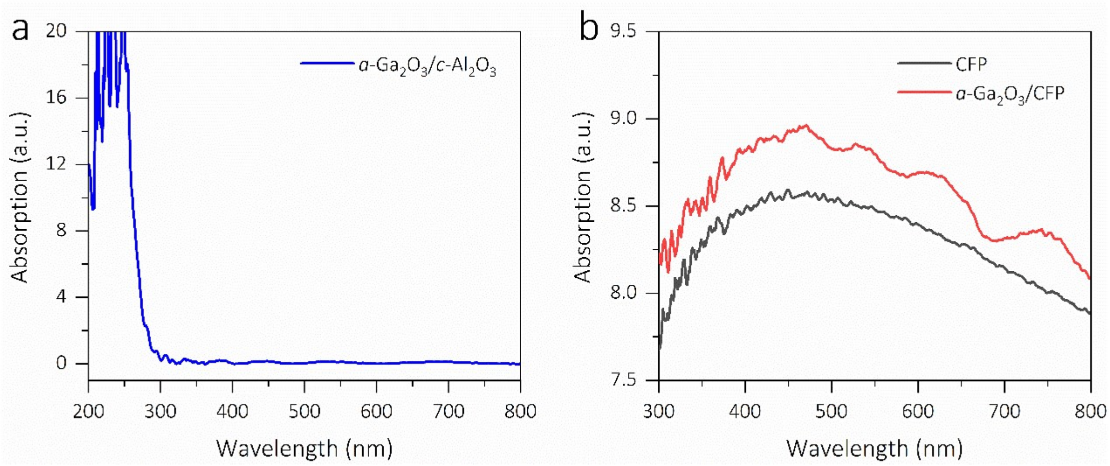

Fig. S4. (a) The absorption spectrum of *a*-Ga_2O_3 film grown on *c*-Al_2O_3 substrate. (b) The absorption spectrum of CFP and *a*-Ga_2O_3 film grown on CFP (*a*-Ga_2O_3/CFP). As seen, the *a*-Ga_2O_3 film grown on *c*-Al_2O_3 substrate has no obvious absorption in the visible light region (see Fig. S4a), however, it can be seen from Fig. S4b that CFP and *a*-Ga_2O_3/CFP have obvious absorption in the visible light region.

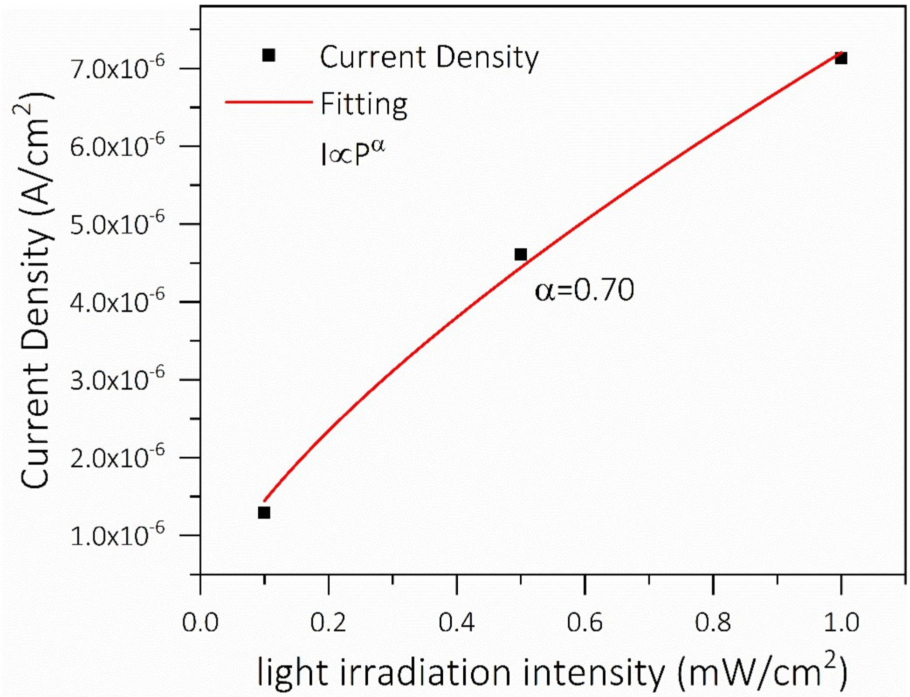

Fig. S5. The current density as a function of the light irradiation intensity at 0 V. As can be seen that the photocurrent density increases almost linearly with the increase of the light irradiation intensity, indicating that the photocurrent mainly depends on the number of photogenerated carriers under DUV irradiation. The dependence of the photocurrent on the light irradiation intensity is calculated by the power law: $I \propto P^{\alpha}$, where P is the light irradiation intensity, and α is the exponent, which demonstrates the response of the photocurrent to the light irradiation intensity. The α obtained by fitting the graph of the photocurrent density change with the light intensity is 0.70. Note that sublinear increase (as α value is <1) in the current density values as the light irradiation intensity increases have been observed.

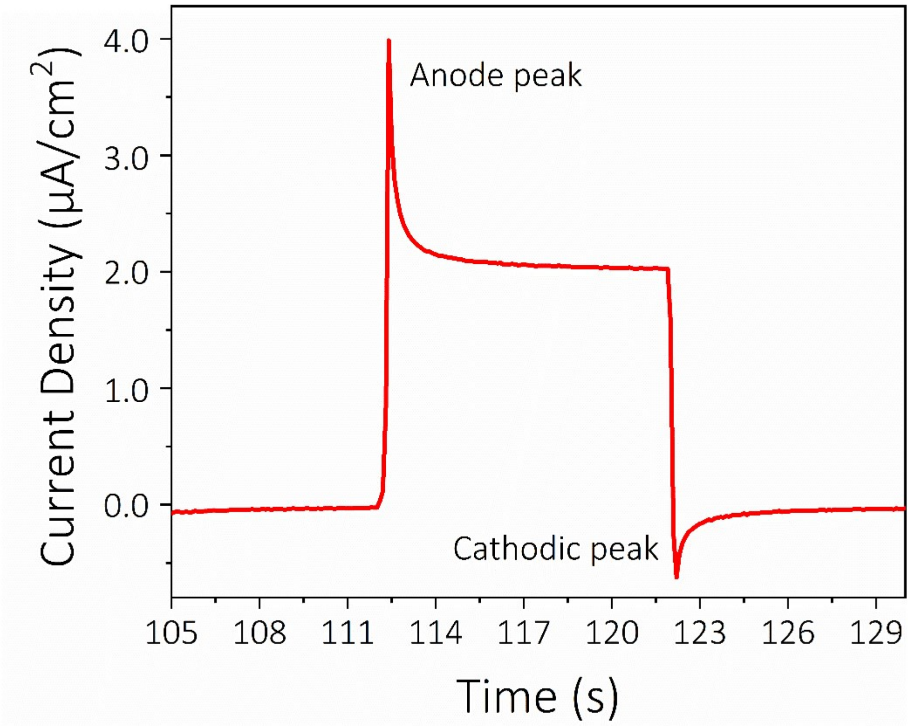

Fig. S6. The photoresponse curve of the self-powered *a*-Ga_2O_3/CFP PEC-PD. As seen, when the DUV light is turned on, the photocurrent density exhibits a sharp anode peak before the exponential decay, and finally reaches a new steady-state photocurrent. After turning off the DUV light, the cathodic current peak is immediately observed, and then the current density gradually returns to the level reached before turning on the DUV light.