Investigating the Role of Temperature in Laser Assisted Chemical Bath Deposition for ZnO Growth for Photodetector Application

Supporting Information

S1. UV photoconductive characterization

There are several electrical parameters that must be acknowledged. Firstly, photocurrent I_{ph} is the current that flows from the cathode to the anode side of the ZnO PD when the ZnO NRs are illuminated by incident UV light. On the other hand, the dark current, I_d, is the current that flows through the ZnO PD when an external reverse voltage is applied with the absence of light.

Rise time τ_r shows the time taken to raise the photocurrent from 10% to 90% of its maximum value, shown in Equation (S**1**). Decay time τ_d shows the time taken to drop the photocurrent from 90% to 10% of its maximum value, shown in Equation (S**2**)[1]. Responsivity R is the output photocurrent obtained in response to the incident light power at a given wavelength falling on the UV PD, provided in Equation (S**3**)[1].

$$\tau_r = \tau_{90\%} - \tau_{10\%} \tag{S1}$$

$$\tau_d = \tau_{10\%} - \tau_{90\%} \tag{S2}$$

$$R = \frac{I_{ph}}{P_{opt}} \tag{S3}$$

where P_{opt} is optical power illuminated on the detection area of the device

To describe the quality of a UV PD or measure its photo-response performance, sensitivity S is the best parameter, which represents the ratio of the photocurrent and dark current provided in Equation (S**4**). Other parameters such as current gain, which shows the on-off ratio of the UV PD, can be also measured directly from the *I-V* characteristic graph provided in Equation (S**5**)[2].

$$S(\%) = \frac{I_{ph}}{I_d} = \frac{I_l - I_d}{I_d} \times 100\% \tag{S4}$$

where I_l is the current when UV-light source switched on

$$Gain = \frac{I_{ph}}{I_d} \tag{S5}$$

Equation (S**6**) provides the detectivity D^* that evaluates the ability of the UV PD to detect a weak signal [3]. Quantum efficiency η tells the number of electron-hole pairs to produce the photocurrent generated by a single incoming photon ($0 \leq \eta \leq 1$), as provided in Equation (S**7**) [4]. Noise Equivalent Power NEP shows the minimum optical power required by a photodetector to distinguish from the noise, as provided in Equation (S**8**).

$$D^* = R\sqrt{\frac{A_O}{2eI_d}} \tag{S6}$$

$$\eta = \frac{I_{ph}/e}{P_{opt}/h\nu} = R\frac{hc}{\lambda e} \tag{S7}$$

$$NEP = \frac{\sqrt{A_O}}{D^*} \tag{S8}$$

where $A_O$is effective area of detector andS λ is wavelength of light that illuminates the detector

References.

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4. Abdulgafour, H. et al., *Enhancing photoresponse time of low cost Pd/ZnO nanorods prepared by thermal evaporation techniques for UV detection.* Applied surface science, 2011. **258**(1): p. 461-465.