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# Epitaxial growth of β-$Ga_2O_3$ (-201) thin film on fourfold symmetry $CeO_2$ (001) substrate for heterogeneous integrations

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Two dimensional Silvaco Atlas TCAD simulation [1] was carried out to understand the spectral response of $Ga_2O_3$ thin film PDs grown on $CeO_2$. The band alignment of the β-$Ga_2O_3$ and $CeO_2$ are set exatctly as in the Figure 4. (e). The schematic diagram of the simulated $Ga_2O_3$ thin film PD grown on $CeO_2$ is shown in Figure S1. (a). The thickness of the $Ga_2O_3$ and $CeO_2$ thin film are set to 300 nm and 20 nm, respectively. The spectral response at a bias of 5V when the beam intensity equals to 20 μW/cm$^2$ and 1 mW/cm$^2$ are shown in the **Figure S1.** (b) and (c). Based on our simulation result, the spectral response only shows a single peak around 250 nm when the beam intensity equals to 20 μW/cm$^2$, which agrees with our experimental result. This behavior could be explained by the thickness of the $CeO_2$ thin film is much less than the above $Ga_2O_3$ film. Moreoever, by artificially increasing the beam intensity to extremely large value (1 mW/cm$^2$), we can see that an additional peak around 350 nm comes out. Thus, we conclude that only the peak of $Ga_2O_3$ in our simulated PD spectral response can be observed when the beam intensity equals to 20 μW/cm$^2$.

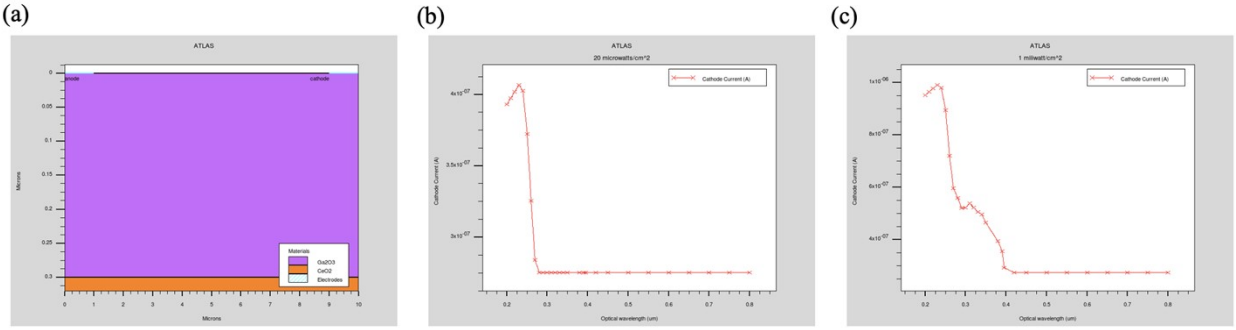


**Figure S1.** (a). Schmatic diagram of the simulated $Ga_2O_3$ thin film PD grown on $CeO_2$. (b). The spectral resonse at a bias of 5 V under the beam intensity equals to 20 μW/cm$^2$. (c). The spectral resonse at a bias of 5 V under the beam intensity equals to 1 mW/cm$^2$.

## Reference

[1] Atlas User's Manual, Silvaco, Santa Clara, CA, USA, 2018.