

## Supplementary information

### **Enhanced detectivity self-powered (photovoltaic) solar-blind UV-C Sn-doped $\beta$ -Ga<sub>2</sub>O<sub>3</sub>-based photodetectors via Sn<sup>+</sup>-implantation with outstanding dark current suppression**

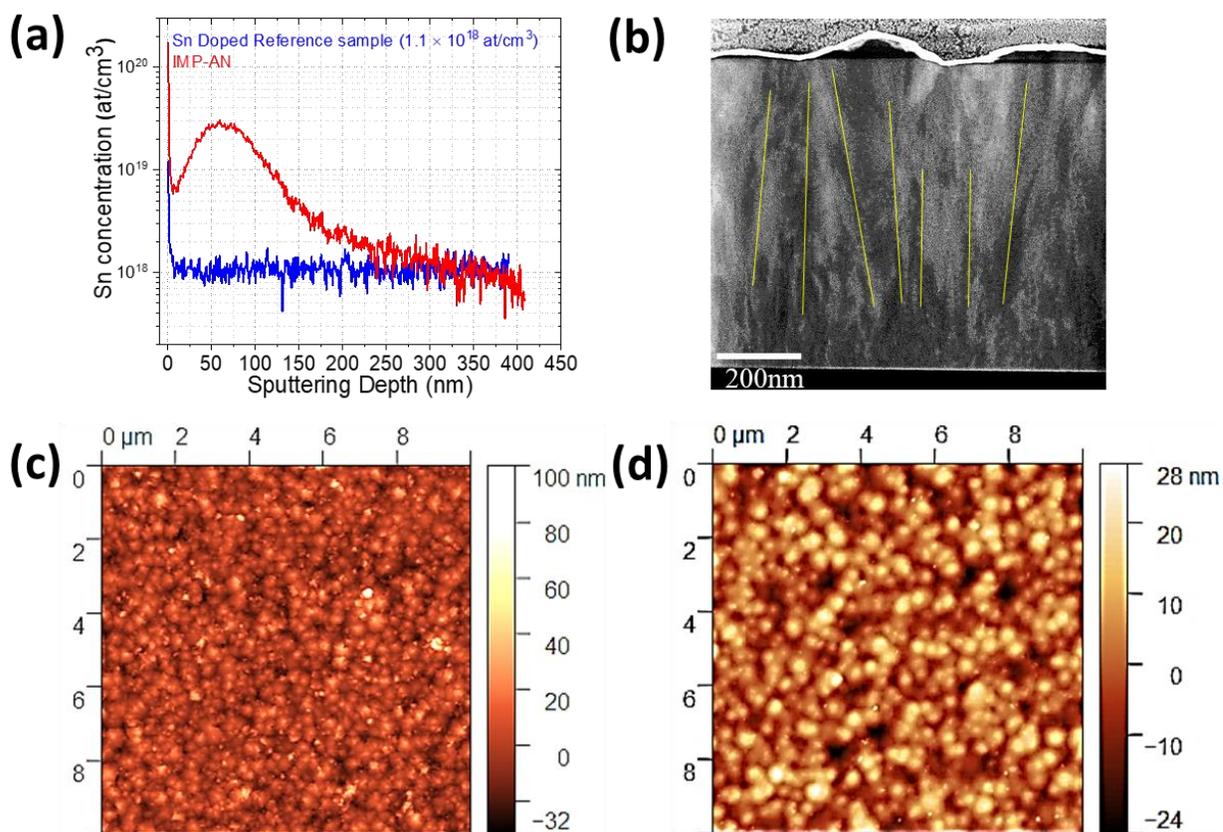
Kishor Upadhyaya<sup>a</sup>, Vijay Gudelli<sup>a</sup>, Fatimah Alreshidi<sup>a</sup>, Duarte Magalhães Esteves<sup>b</sup>, Marco Peres<sup>b</sup>, Mohamed Nejib Hedhili<sup>c</sup>, Nimer Wehbe<sup>c</sup>, Katharina Lorenz<sup>b</sup> and Iman S. Roqan<sup>a,\*</sup>

<sup>a</sup> Semiconductor and Material Spectroscopy (SMS) Group, King Abdullah University of Science and Technology (KAUST), Saudi Arabia

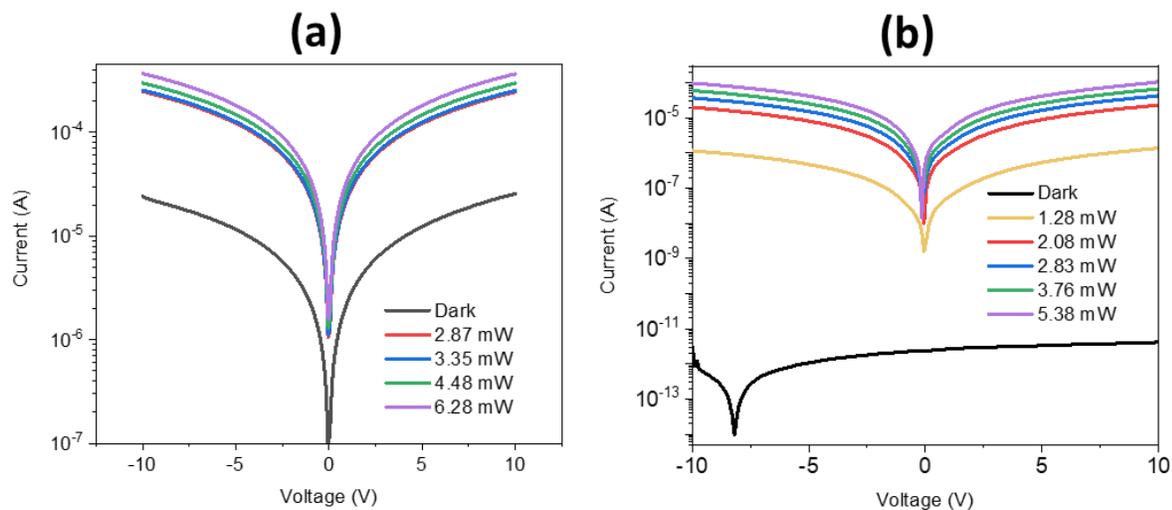
<sup>b</sup> INESC MN and IPFN, Instituto Superior Técnico, Campus Tecnológico e Nuclear, Lisbon, Portugal

<sup>c</sup> KAUST Core Laboratories, King Abdullah University of Science and Technology (KAUST), Thuwal 23955-6900, Saudi Arabia

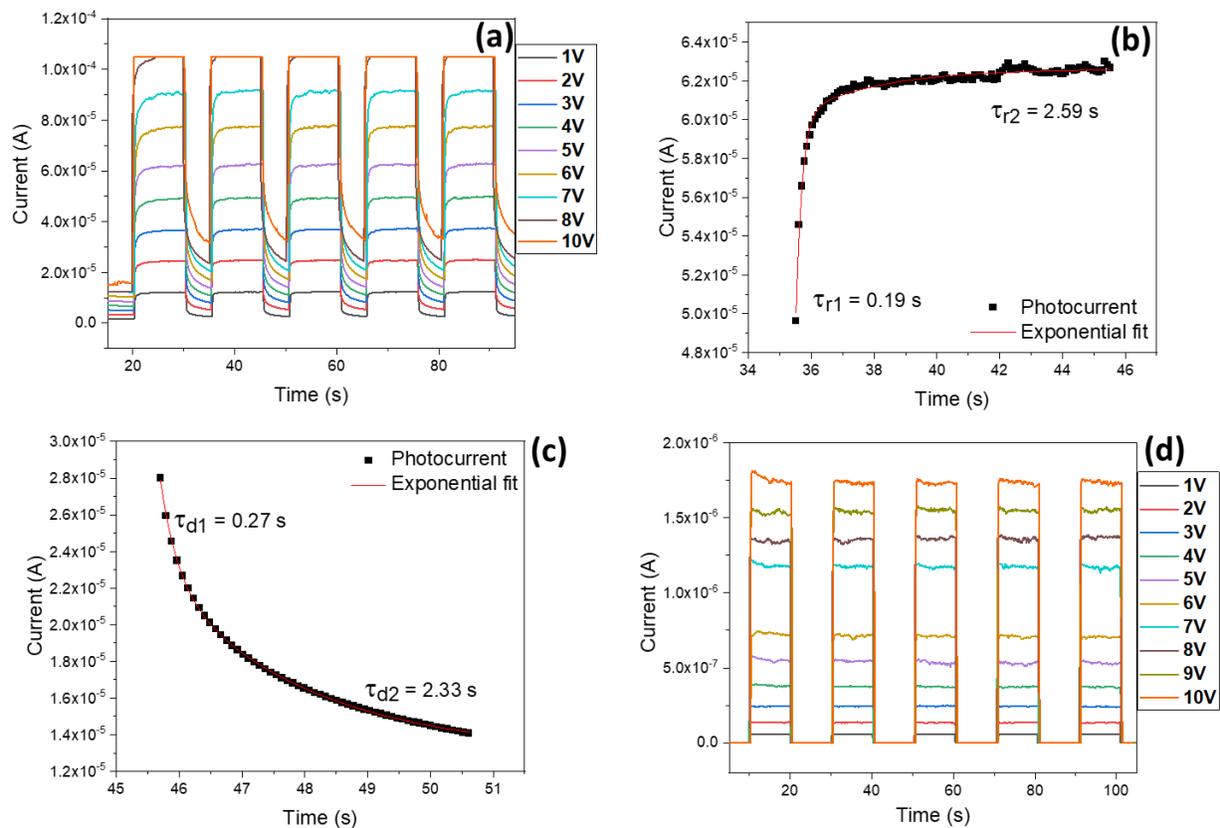
\*Corresponding author email: iman.roqan@kaust.edu.sa



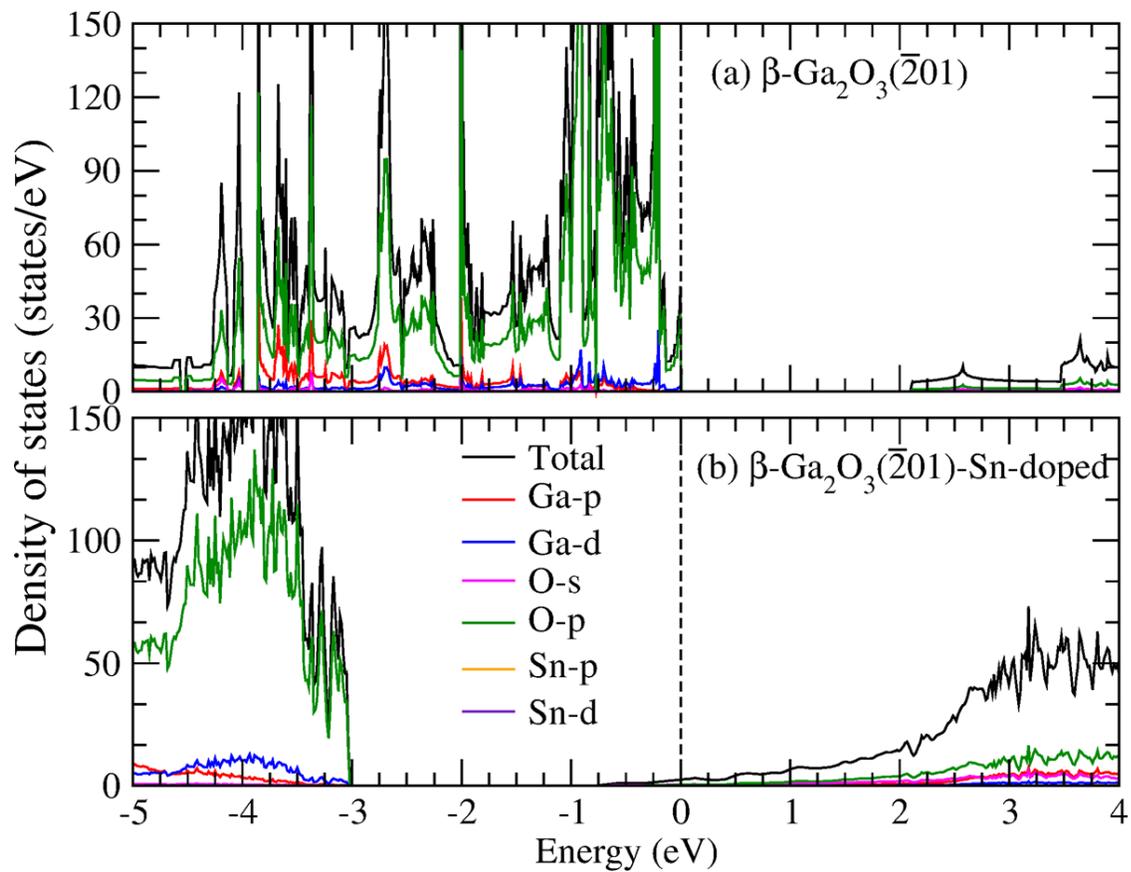
Supplementary Fig. 1: (a) SIMS plot showing Sn concentration vs depth for IMP-AN film, (b) TEM image showing elongated grains in AG film. AFM images of (c) AG and (d) IMP-AN films.



Supplementary Fig. 2: I-V curves for different illumination density for PD devices based on (a) AG and (b) IMP-AN films.



Supplementary Fig. 3: (a) Time dependent photocurrent measurements for different bias voltages with double exponential function-fitted curves showing (b) rise time and (c) decay time of PD based on AG film. Time dependent photocurrent measurements for different bias voltages and (d) IMP-AN films based PD devices.



Supplementary Fig. 4. Density of states of (a) Pristine  $\beta\text{-Ga}_2\text{O}_3$  and (b) Sn doped  $\beta\text{-Ga}_2\text{O}_3$