

## GeSe-embedded metal-oxide double heterojunctions for facilitating self-biased and efficient NIR photodetection.

Muhammad Hussain<sup>a,f</sup>, Sohail Abbas<sup>b</sup>, Usama Waleed Qazi<sup>c</sup>, Muhammad Riaz<sup>a</sup>, Asif Ali<sup>a</sup>, Fazal Wahab<sup>d</sup>, Anis Ftima<sup>e</sup>, Sajjad Hussain<sup>a</sup>, Zdenek Sofer<sup>f</sup> & Jongwan Jung<sup>a\*</sup>

<sup>a</sup> Department of Nanotechnology and Advanced Materials Engineering, and HMC, Sejong University, 05006, South Korea.

<sup>b</sup> Department of Electrical Engineering, Riphah International University, Islamabad, Pakistan.

<sup>c</sup> Department of Mechanical Engineering, Institute of Space Technology, Islamabad, Pakistan.

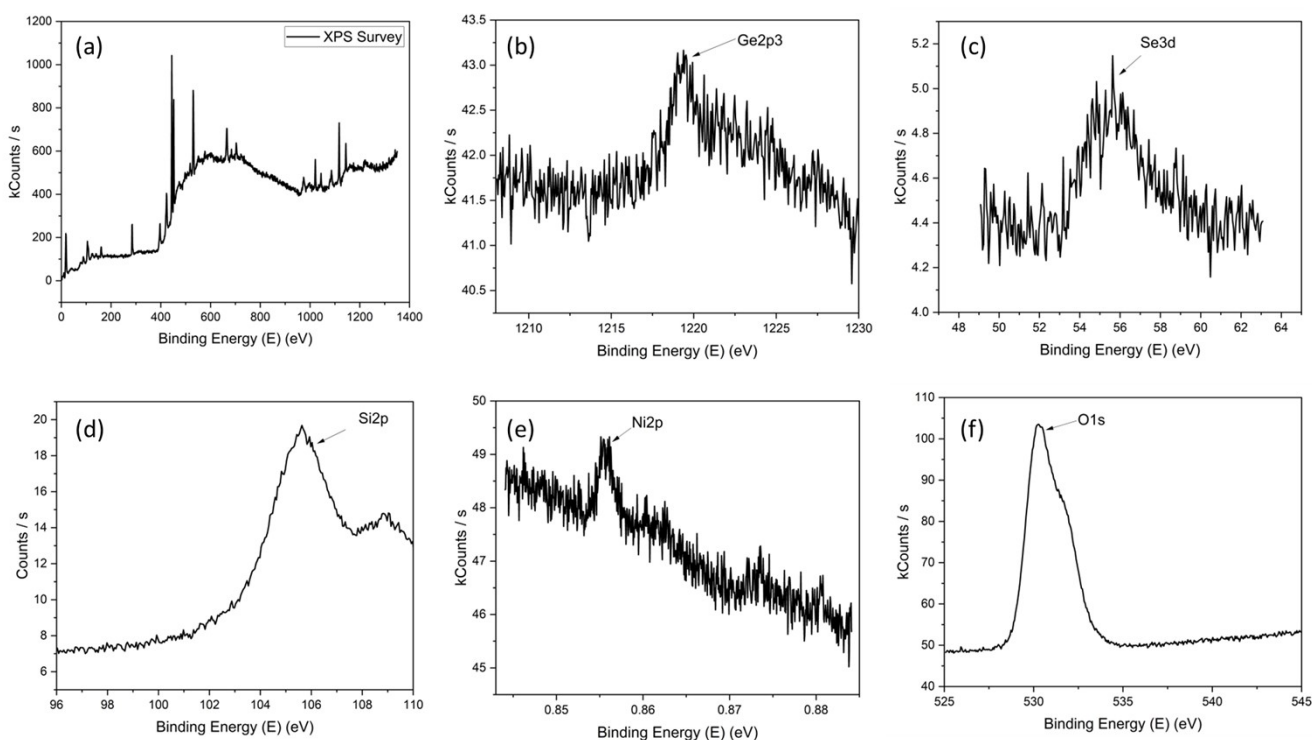
<sup>d</sup> Department of Physics, Karakoram International University, Gilgit, Pakistan.

<sup>e</sup> Department of Chemistry, University of Wah, Punjab, Pakistan.

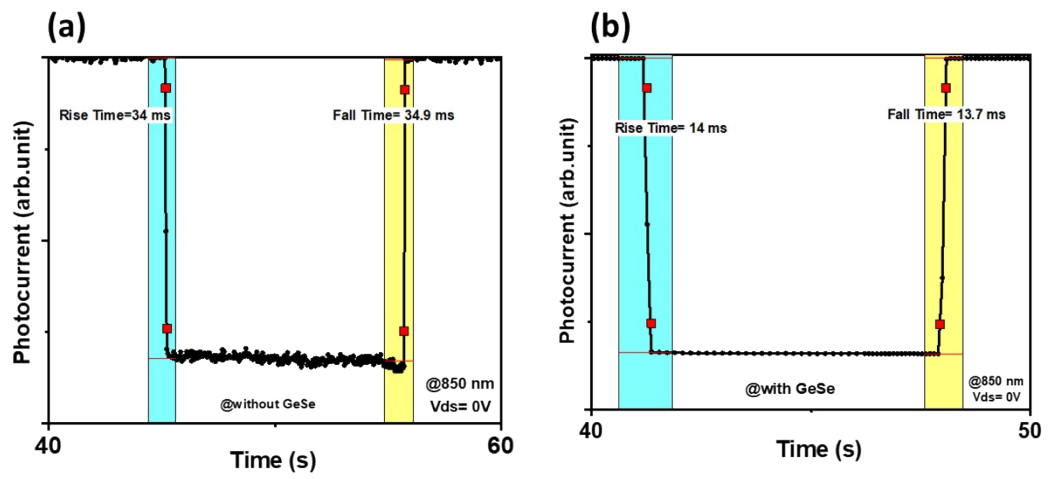
<sup>f</sup> Department of Inorganic Chemistry, University of Chemistry and Technology Prague, Technická 5, 166 28 Prague 6, Czech Republic.

\*Corresponding author: [jwjung@sejong.ac.kr](mailto:jwjung@sejong.ac.kr)

## Supporting Information



**Figure S1.** (a-h) X-ray photoelectron spectroscopy (XPS; PHI 5000 Versa Probe) under Al K $\alpha$  at 25 W and  $6.7 \times 10^{-8}$  Pa was used to confirm the chemical composition and binding energy of the NiO and GeSe film on Si.



**Figure S2:** Response speed of the devices: (a) without GeSe interlayer and (b) with GeSe layer