ET-003

Interfacial Energetics of All Oxide Transparent Photodiodes

Pankaj Yadav, Hong-sik Kim, Malkeshkumar Patel and Joondong Kim

광전 및 에너지소자 연구실(Photoelectric and Energy Device Application Lab, PEDAL)

The present work explains the interfacial energetics of all oxide transparent photodiodes. The optical, structural and morphological of copper oxides were systematically analyse by UV-Visible spectrometer, X-Ray diffraction, Raman spectroscopy, Scanning electron microscopy (SEM) and Atomic force microscopy measurements (AFM). The UV-Visible result exhibits optical bandgap of Cu2O and CuO as 2.2 and 2.05 eV respectively. SEM and AFM result shows a uniform grain size distribution in Cu2O and CuO thin films with the average grain size of 45 and 40 nm respectively. The results of Current-Voltage and Kelvin probe force microscope characteristics describe the electrical responses of the Cu2O/ZnO and CuO/ZnO heterojunctions photodiodes. The obtained electrical response depicts the approximately same knee voltages with a measurable difference in the absolute value of net terminal current. More over the present study realizes the all oxide transparent photodiode with zero bias photocurrent. The presented results lay the template for fabricating and analysing the self-bias all oxide transparent photodetector.

Keywords: Metal oxides, Photodiodes, Self-bias operation

ET-004

Optically transparent and electrically conductive indium-tin-oxide nanowires for transparent photodetectors

Hyunki Kim, Wanghee Park, Dongkyun Ban, Hong-Sik Kim, Malkeshkumar Patel, Pankaj Yadav and Joondong Kim

광전 및 에너지소자 연구실(Photoelectric and Energy Device Application Lab, PEDAL)

Single crystalline indium-tin-oxide (ITO) nanowires (NWs) were grown by sputtering method. A thin Ni film of 5 nm was coated before ITO sputtering. Thermal treatment forms Ni nanoparticles, which act as templates to diffuse Ni into the sputtered ITO layer to grow single crystalline ITO NWs.

Highly optical transparent photoelectric devices were realized by using a transparent metal-oxide semiconductor heterojunction by combining of p-type NiO and n-type ZnO. A functional template of ITO nanowires was applied to this transparent heterojunction device to enlarge the light-reactive surface. The ITO NWs/n-ZnO/p-NiO heterojunction device provided a significant high rectification ratio of 275 with a considerably low reverse saturation current of 0.2 nA. The optical transparency was about 80% for visible wavelengths, however showed an excellent blocking UV light. The nanostructured transparent heterojunction devices were applied for UV photodetectors to show ultra fast photoresponses with a rise time of 8.3 mS and a fall time of 20 ms, respectively. We suggest this transparent and super-performing UV responser can practically applied in transparent electronics and smart window applications.

Keywords: ITO nanowire, metal oxide semiconductor, NiO, ZnO, UV photodetector