[TA1-D-1]

Characterization of Photo-Responsive Mechanism through Subgap Density-of-States in a-IGZO TFTs for Possible Infrared Light Detection

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Amorphous InGaZnO (a-IGZO) thin-film transistors (TFTs) are under wide investigation due to their low-temperature deposition process, large-area uniformity, high field-effect mobility, high on/off ratio, and transparency to visible light [1]. Because a-IGZO has a wide bandgap (E_g>3 eV), there were reports on the application to phototransistors for detection of ultraviolet (UV) light [2]. We investigate the sub-bandgap photonic($h\nu<E_g$) response for possible application to phototransistors without additional fabrication process specified for sub-bandgap light detection. The origin of the photonic response is the optically pumped electrons from the photo-responsive subgap states ($E_C-E_{ph}<E_t<E_F$) distributed over the bandgap. Among the sub-bandgap photons, we investigate the reproducible IR light response because visible light induces a persistent photoconductivity (PPC) effect in a-IGZO TFTs. Here, we demonstrate the mechanism of the IR light response by changing the wavelength (λ) from λ=830 nm to λ=1310 nm as a function of the optical power (P_{opt}) through I-V characteristics. Our investigation may provide a useful way to realize an integration of IR detectors with a-IGZO TFTs for a variety of applications.

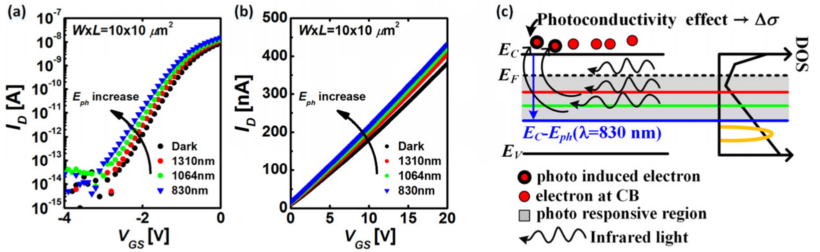

Fig 1. (a) Subthreshold and (b) above threshold I-V curves with wavelength variation. (c) Schematic of a-IGZO energy band diagram and DOS distribution.

[1] K. Nomura, *et al*, *Nature* **432**, 488 (2004).
[2] C.-S. Chuang, *et al*, *SID. Symp. Dig.* **39**, 1215 (2008).

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[TA1-D-2]

Improved gas sensing properties of solution-processed hybrid IGZO/CNT films

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Since the report on gas sensors based on amorphous oxide semiconductors (AOS) was demonstrated, various approaches to realize high sensitivity and fast response in sensing operation have been intensively investigated [1]. However, active commercialization of AOS-based gas sensors in the bio-electronics which can be utilized for breath analyzer in health care monitoring systems, is limited due to high operation temperature between 200 and 400 °C [2]. In particular, highly sensitive gas sensing (up to sub-ppb) can be obtained with nanostructures which increase the surface to volume ratio. Recently, we have realized high performance indium-gallium-zinc-oxide (IGZO) gas sensors operated at room temperature by employing a structural integration of materials with single-walled carbon nanotubes (CNTs) via solution-process. With an optimized solution process including a concentration, the gas sensitivity which is obtained by a change in the electrical properties due to the adsorption of ethanol molecules in hybrid IGZO/CNT films, was improved from 2% to 10% without any additional condition.

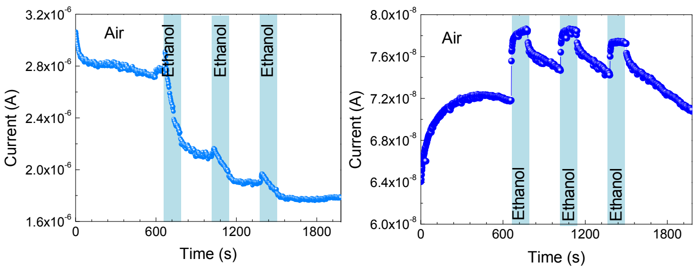

Fig. 1. The properties of gas sensing based on (a) CNT and (b) IGZO/CNT films

[1] D. J. Yang, G. C. Whitfield, N. G. Cho, P. -S. Cho, I. -D. Kim, H. M. Saltsburg, and H. L. Tuller, *Sensor and Actuators B*, **171**, 1166 (2012).
[2] R. Jaisutti, J. Kim, S. K. Park, and Y. -H. Kim, *ACS Appl. Mater. Interface.*, **8**, 20192 (2016).