Fundamentals and Technology of Multifunctional Materials and Devices
Room On Demand - Session CP

Fundamentals and Technology of Multifunctional Materials and Devices (Symposium C) Poster Session

CP-1 Freestanding ZnO Nanowire For Multifunctional Application in RRAM Memory and Gas Sensing, ***Pragya Singh (pragyasingh@mail.ntust.edu.tw)***, National Taiwan University of Science and Technology, Taiwan; *T. Tseng* , National Chiao Tung university , Taiwan; *J. Chu,* National Taiwan University of Science and Technology, Taiwan

In current research, the focus of nanoscale community is to produce various nanostructures in such a way that can be easily modified as desired applications ranging from nanoptoronics to biomedical engineering. Nanoscale structure from various metal oxide materials has got great attention due to its various fabrication strategies, characterizations, surface morphology, structure-property correlations, and various remarkable milestones indeed have been entrenched. Zinc oxide (ZnO) is a well-known n-type semiconductor with a wide bandgap (3.37eV) and large excitation binding energy (60eV) material, that has been extensively investigated in multifunctional devices due to the low production cost, chemical stability, doping, and the non-toxic property. In this study, we fabricated the ZnO nanowires by hydrothermal method, applicable in resistive random access memory (RRAM) as well as in gas sensing devices. The hydrothermal growth technique is a solution-based process used to synthesize ZnO nanowires on ITO coated glass substrate. Electrical characteristics were carried out by a semiconductor device analyzer (Agilent Tech. Inc. B1500) and gas sensing electrical measurement system (model 2400, Keithley Source Meter) at room temperature. After introducing ZnO nanowire thin film between conductive electrodes, both devices show significant enhancement in their resistive switching and sensing properties. To check the surface morphology and orientation of nanowire thin film, ZnO nanowires were examined by using scanning electron microscopy (SEM). The crystal structures of the ZnO nanowire thin film were investigated through X-ray diffractometry (XRD). The defect concentrations in the nanowire thin film were evaluated using an X-ray photoelectron spectroscopy (XPS). To understand the filament formation during resistive switching analysis and gas sensing behavior, a schematic representation is used. Our study proposes that ZnO-based devices have been shown effective results and this technique can be easily adopted by other oxide and may encourage the fabrication of various hybrid devices in near future for multifunctional applications.

CP-2 Introducing Thin HfO_2 Layer to Inhibit the Power Consumption of InWZnO CBRAM, ***You-Xuan Li (youxuan.eo08g@nctu.edu.tw)***, *P. Liu, C. Hsu, K. Gan, D. Ruan, Y. Chiu,* National Chiao Tung University, Taiwan

In this study, the memory performance of IWZO-based CBRAM device can be greatly improved by inserting a thin HfO2 layer with different process methods. The bilayer structure (IWZO/ALD-HfO_2) device also exhibit excellent memory characteristics, such as high endurance cycle (more than 2 ´ 10^3), long retention time (more than 2 ´ 10^4 s), lower set and reset voltage. The IWZO-based memory device with bilayer structure can be operated at 10 mA for low-power device application. This improvement in resistive switching characteristics are attributed to Gibbs free energy of HfO_2 lower than IWZO layer, which is easily occur oxidation reaction in HfO_2 layer. These results proposed a method that inserting a thin ALD-HfO_2 layer in IWZO-based CBRAM device can not only reduce the off-state leakage current, but also enhance the reliability of the memory, which has great potential for future memory-in-pixel applications in low-power Internet of Things (IoT) generations.

CP-3 Improved Electrical Performance for Indium Tungsten Oxide Thin-Film Transistor with Asymmetric Source and Drain ElectrodeMaterial, ***Chia-Yu Lin (mandylin21107@gmail.com)***, *P. Liu,* National Chiao Tung University, Taiwan; *D. Ruan,* National Chiao Tung University, China; *K. Gan, Y. Chiu, C. Hsu,* National Chiao Tung University, Taiwan; *S. Sze,* National Chiao Tung University, USA

In this work, high mobility indium tungsten oxide thin-film transistor (TFT) with asymmetric schottky contact has been fabricated, while the improvement on electrical characteristics was also discussed. In general, metal material with low work function is often selected as the source and drain (S/D) electrode. It can be attributed to a low schottky barrier which was formed with channel material naturally. However, a high conductivity channel material with low schottky barrier may induce an undesirable negative threshold voltage and poor on/off current ratio. Utilizing asymmetric S/D schottky barrier, a lower off-state current and subthreshold swing can be achieved, while the on-state current and field effect mobility have been kept. The research may provide a new approach to enhance the electrical performance and adjust threshold voltage for TFT with high conductivity channel material.

Author Index

Bold page numbers indicate presenter