TM-P028

Electrical Characterization of Amorphous Zn-Sn-O Transistors Deposited through RF-Sputtering

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Flat-panel displays have been growing as an essential everyday product in the current information/communication ages in the unprecedented speed. The forward-coming applications require light-weightness, higher speed, higher resolution, and lower power consumption, along with the relevant cost. Such specifications demand for a new concept-based materials and applications, unlike Si-based technologies, such as amorphous Si and polycrystalline Si thin film transistors. Since the introduction of the first concept on the oxide-based thin film transistors by Hosono et al., amorphous oxide thin film transistors have been gaining academic/industrial interest, owing to the facile synthesis and reproducible processing despite of a couple of shortcomings. The current work places its main emphasis on the binary oxides composed of ZnO and SnO2. RF sputtering was applied to the fabrication of amorphous oxide thin film devices, in the form of bottom-gated structures involving highly-doped Si wafers as gate materials and thermal oxide (SiO2) as gate dielectrics. The physical/chemical features were characterized using atomic force microscopy for surface morphology, spectroscopic ellipsometry for optical parameters, X-ray diffraction for crystallinity, and X-ray photoelectron spectroscopy for identification of chemical states. The combined characterizations on Zn-Sn-O thin films are discussed in comparison with the device performance based on thin film transistors involving Zn-Sn-O thin films as channel materials, with the aim to optimizing high-performance thin film transistors.

Keywords: Zn-Sn-O, RF-sputtering, display

TM-P029

Influence of Annealing Temperature on Structural and Thermoelectrical Properties of Bismuth-Telluride-Selenide Ternary Compound Thin Film

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Chalcogenides (Te,Se) and pnictogens(Bi,Sb) materials have been widely investigated as thermoelectric materials. Especially, Bi2Te3 (Bismuth telluride) compound thermoelectric materials in thin film and nanowires are known to have the highest thermoelectric figure of merit ZT at room temperature. Currently, the thermoelectric material research is mostly driven in two directions: (1) enhancing the Seebeck coefficient, electrical conductivity using quantum confinement effects and (2) decreasing thermal conductivity using phonon scattering effect. Herein we demonstrated influence of annealing temperature on structural and thermoelectrical properties of Bismuth-telluride-selenide ternary compound thin film. Te-rich Bismuth-telluride- selenide ternary compound thin film prepared co-deposited by thermal evaporation techniques. After annealing treatment, co-deposited thin film was transformed amorphous phase to Bi2Te3-Bi2Te2Se1 polycrystalline thin film. In the experiment, to investigate the structural and thermoelectric characteristics of Bi2Te3-i2Te2Se1 films, we measured Rutherford Backscattering spectrometry (RBS), X-ray diffraction (XRD), Raman spectroscopy, Scanning eletron microscopy (SEM), Transmission electron microscopy (TEM), Seebeck coefficient measurement and Hall measurement. After annealing treatment, electrical conductivity and Seebeck coefficient was increased by defect states dominated by selenium vacant sites. These charged selenium vacancies behave as electron donors, resulting in carrier concentration was increased. Moreover, Thermal conductivity was significantly decreased because phonon scattering was enhanced through the grain boundary in Bi2Te3- Bi2Te2Se1 polycrystalline compound. As a result, The enhancement of thermoelectric figure-of-merit could be obtained by optimal annealing treatment.

Keywords: Bismuth Telluride Selenide, thin film, structural property, thermoelectric, phonon scattering, grain boundary