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Structural and Electrical Features of Solution-Processed Li-doped ZnO Thin Film Transistor Post-Treated by Ambient Conditions

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Transparent oxide semiconductors are increasingly becoming one of good candidates for high efficient channel materials of thin film transistors (TFTs) in large-area display industries. Compare to the conventional hydrogenated amorphous silicon channel layers, solution processed ZnO-TFTs can be simply fabricated at low temperature by just using a spin coating method without vacuum deposition, thus providing low manufacturing cost. Furthermore, solution based oxide TFT exhibits excellent transparency and enables to apply flexible devices. For this reason, this process has been attracting much attention as one fabrication method for oxide channel layer in thin-film transistors (TFTs). But, poor electrical characteristic of these solution based oxide materials still remains one of issuable problems due to oxygen vacancy formed by breaking weak chemical bonds during fabrication. These electrical properties are expected due to the generation of a large number of conducting carriers, resulting in huge electron scattering effect. Therefore, we study a novel technique to effectively improve the electron mobility by applying environmental annealing treatments with various gases to the solution based Li-doped ZnO TFTs. This technique was systematically designed to vary a different lithium ratio in order to confirm the electrical tendency of Li-doped ZnO TFTs. The observations of Scanning Electron Microscopy, Atomic Force Microscopy, and X-ray Photoelectron Spectroscopy were performed to investigate structural properties and elemental composition of our samples. In addition, I-V characteristics were carried out by using Keithley 4,200-Semiconductor Characterization System (4,200-SCS) with 4-probe system.

Keywords: oxide TFTs, Li-doped ZnO TFTs, sol-gel, solution process