Effects of carrier concentration in the active channel layer on electrical characteristics of ZnO-based TFTs

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We report the fabrication and characteristics of thin film transistors with ZnO channel layers (ZnO-TFTs) having different carrier concentrations. Also, we define the operation mechanism of ZnO-TFTs as the variation of carrier concentration of the ZnO channel layer. The ZnO thin films were deposited on SiO₂/p-Si substrate by DC magnetron sputtering at various oxygen partial pressures. Effects of carrier concentration of ZnO thin films on the electrical performance of ZnO-TFTs with bottom gate structure were investigated. The ZnO thin films deposited at O₂ partial pressures of 40 % exhibit a non-stoichiometric system in an oxygen rich state, resulting in carrier concentrations as low as \( \sim 10^{12} \text{ cm}^{-3} \). Our research implied that an attractive application for TFTs involves their use as select-transistors in individual pixels of an active-matrix liquid-crystal display.