Optical- and Electrical properties of ZnO_xN_y Films grown by Atomic Layer Deposition

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ZnO has been attracted as an active channel of thin film transistors (TFTs) for realizing transparent display panels and flexible electronics due to its wide band gap energy (E_g = 3.36 eV) and low temperature process. However, the electronic mobility of ZnO films is approximately 10 $cm^2V^{-1}s^{-1}$ and the value is still far from being enough for large scale displays. The instability of transport properties of ZnO TFTs under the light irradiation is also critical. Recently, it was reported that the incorporation of nitrogen into ZnO films significantly improved the electronic mobility and photostability [1]. Therefore, we suggest atomic layer deposition (ALD) of ZnO_xN_y films for the improvement of the electrical properties. ALD is a thin film growth technique for high quality thin films with a precise thickness control and composition control at a relatively low temperature, which facilitates TFTs on large area flexible substrates. We deposited ZnO_xN_y films by ALD with DEZ, H_2O and NH_3 at 150 ^oC. For controlling the incorporation of nitrogen into ZnO, a cycle ratio ($R_{H2O/NH3}$) of [DEZ-H_2O]:[DEZ-NH_3] varied from 1:0 to 1:9. A growth per cycle of the ZnO films increased with $R_{H2O/NH3}$ despite no formation of Zn_3N_2 by ALD at this temperature. This might result from the easy chemisorption of NH_3 on the ZnO surface. The optical band-gap was controlled even at a very low $R_{H2O/NH3}$. Also, electrical properties of ZnO_xN_y films were changed systematically by the variation in the $R_{H2O/NH3}$. In the presentation, we will report the detailed optical- and electrical properties of ZnO_xN_y and the transport properties of TFTs using the ZnO_xN_y films.

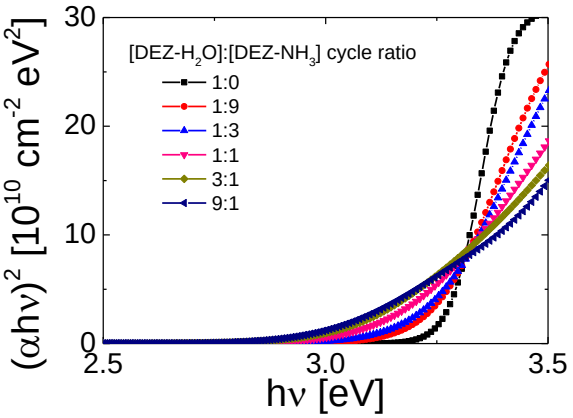

Fig. 1. Optical absorption spectra of the ZnO_xN_y films grown at the $R_{H2O/NH3}$ range from 1:0 to 1:9

Reference

1. E. H. Lee, A. Benayad, T. H. Shin, H. G. Lee, D. S. Ko, T. S. Kim, K. S. Son, M. K. Ryu, S. H. Jeon, G. S. Park, *Scientific reports*, 4, 4948 (2014).