Study of Atmospheric-Pressure Plasma Enhanced Chemical Vapor Deposition Fabricated Indium Gallium Zinc Oxide Thin Film Transistors with In-Situ Hydrogen Plasma Treatment

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Abstract

Amorphous InGaZnO (a-IGZO) Thin Film Transistors (TFTs) has been studied extensively for their perspective applications in next generation active-matrix displays such as liquid crystal displays and flat-panel displays, due to its better field-effect mobility (>10 cm(2)/V.S), larger I-on/I-off ratio (>10(6)), and better stability electrical. Hydrogen is known as shallow donors for n-type (channel) oxide semiconductors (Dong, J.J., et al. 2010. Effects of hydrogen plasma treatment on the electrical and optical properties of Zno films: Identification of hydrogen donors in ZnO. ACS Appl. Mater. Interfaces, 2, pp.1780-1784), and it is also effective passivator for traps (Tsao, S.W., et al., 2010. Hydrogen-induced improvements in electrical characteristics of a-IGZO thin-film transistors. Solid-State Electron, 54, pp.1497-1499). In this study, In-Situ hydrogen plasma is applied to deposit IGZO channel. With atmospheric-pressure PECVD (AP-PECVD), IGZO thin film can be deposited without vacuum system, large area manufacturing, and cost reducing (Chang, K.M., et al., 2011. Transparent conductive indium-doped zinc oxide films prepared by atmospheric pressure plasma jet. Thin Solid Films, 519, pp.5114-5117). The results show that with appropriate flow ratio of Ar/H-2 plasma treatment, the a-IGZO TFT device exhibits better performance with mobility (mu(FE)) 19.7 cm(2)/V.S, threshold voltage (V-T) 1.18 V, subthreshold swing (SS) 81 mV/decade, and I-on/I-off ratio 5.35 x 10(7).

Keyword: AP-PECVD; IGZO TFTs; Hydrogen Plasma