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PII: S0040-6090(18)30028-2
DOI: https://doi.org/10.1016/j.tsf.2018.01.020
Reference: TSF 36419

To appear in: *Thin Solid Films*

Received date: 27 July 2017
Revised date: 11 December 2017
Accepted date: 13 January 2018

Extraction method of trap densities for indium zinc oxide thin-film transistors processed by solution method

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Abstract. In accordance with the positive bias stress (PBS) instability, generalized equations are derived to extract distributions of trap states in indium zinc oxide (IZO) thin film transistors (TFTs) processed by solution method. In this extraction method, densities of both interface trap states and bulk trap states can be obtained simultaneously. It demonstrates that in the double-active-layer IZO TFT, the front-channel (the bottom layer) annealed by rapid thermal annealing (RTA) in oxygen (O_2) atmosphere with high flow rate has more traps at the interface between insulator and IZO than that annealed in nitrogen (N_2). Meanwhile, the density of bulk trap states in the bilayer stack IZO TFTs is lower than that in the single-active-layer IZO TFTs. In addition, the specific association of electric characteristics with trap states density also has been explored. Results imply that the subthreshold swing of TFT relies more heavily on interface states. Furthermore, contrary to IZO TFT with single active layer, the positive shift of transfer curves per second increased for stacked TFT in the range from 100 to 200 seconds, at this point one should take into account the interfacial region between two active layers. Nevertheless, on the whole, double-layered active structure can optimize the performance of devices to some extent.

Keywords: indium zinc oxide (IZO), thin film transistors (TFTs), solution method, trap states, positive bias stress instability.

1 Introduction

During the past decade, indium zinc oxide (IZO) has been widely recognized as an appropriate active material in thin film transistors (TFTs) for optoelectronic applications, large and flexible displays [1, 2]. So far, strenuous efforts had been made to the exploration of IZO TFTs: Paine et al. dug into the feature of IZO TFT processed by dc-magnetron sputter techniques [3]. Fortunato et al. proposed a bottom gate TFT deposited by radio frequency (rf) magnetron sputtering at room temperature, in which the channel and drain/source regions are based on the same material, amorphous IZO. A key advantage of this TFT is its high electron saturation mobility (>100 $cm^2V^{-1}s^{-1}$) [4]. Sheng et al. reported an amorphous IZO TFT fabricated by atomic layer

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