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PII: S0040-6090(18)30594-7
DOI: doi:10.1016/j.tsf.2018.07.053
Reference: TSF 36865

To appear in: *Thin Solid Films*

Received date: 24 March 2018
Revised date: 4 July 2018
Accepted date: 23 July 2018

Please cite this article as: Dun-Bao Ruan, Po-Tsun Liu, Yu-Chuan Chiu, Min-Chin Yu, Kai-Jhih Gan, Ta-Chun Chien, Yi-Heng Chen, Po-Yi Kuo, Simon M. Sze , Performance Improvements of Tungsten and Zinc Doped Indium Oxide Thin Film Transistor by Fluorine based double Plasma Treatment with a High-K Gate Dielectric. Tsf (2018), doi:10.1016/j.tsf.2018.07.053

Performance Improvements of Tungsten and Zinc Doped Indium Oxide Thin Film Transistor by Fluorine Based Double Plasma Treatment with a High-K Gate Dielectric

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Abstract

The electrical characteristics and XPS analysis for the amorphous tungsten and zinc doped indium oxide thin film transistor, which was performed with single or double different fluorine based remote plasma treatment, were investigated in this study. A high mobility TFT device with the tungsten doped channel was fabricated in the previous study, but there was an inevitable negative shift for the threshold voltage, which will be a limit for the application of systemic circuit design. Therefore, a double fluorine based remote plasma treatment process is proposed for the high electronegativity of fluorine element and its similar radius as oxygen, which can be used to terminate the donor-like oxygen vacancy. It may induce a positive shift of threshold voltage, while carrier concentration and field effect mobility might be maintained. As a result, the sample with CF_4/N_2+O_2 plasma treatment exhibits a higher on/off current ratio of ~4.73×10^6, a lower sub-threshold swing value of 0.070 V/decade, and a lower interfacial trap density value of 5.21×10^{11} $eV^{-1}cm^{-2}$ than other samples, while there is even a desirable