Correlation between Carrier Transport and Orientation Evolution of Polycrystalline Transparent Conductive Al-Doped ZnO Films

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PII: S0040-6090(16)30466-7
DOI: doi: 10.1016/j.tsf.2016.07.078
Reference: TSF 35408

To appear in: *Thin Solid Films*

Received date: 1 April 2016
Revised date: 11 July 2016
Accepted date: 18 July 2016

Please cite this article as: Junichi Nomoto, Hisao Makino, Tetsuya Yamamoto, Correlation between Carrier Transport and Orientation Evolution of Polycrystalline Transparent Conductive Al-Doped ZnO Films, *Thin Solid Films* (2016), doi: 10.1016/j.tsf.2016.07.078

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Abstract

We have been developing a deposition technology to achieve Al-doped ZnO (AZO) polycrystalline films with a well-defined (0001) orientation. We propose the use of very thin *critical layers* (*CLs*) made from Ga-doped ZnO (GZO) films deposited by ion plating with direct-current arc discharge, which strongly affect the orientation of AZO films deposited by direct-current magnetron sputtering. The Al_2O_3 content in the sputtering target was 0.5 wt.%. 500-, 200- and 100-nm-thick AZO films with *CLs* exhibited high μ_H values of 50.1 cm^2/Vs, 40.2 cm^2/Vs and 32.5 cm^2/Vs, respectively, compared with those of *CL*-free AZO films. The presence of *CLs* with a preferential *c*-axis orientation as interfaces between AZO films and glass substrates plays a critical role in producing AZO films having a textured polycrystalline structure with a well-defined (0001) orientation.

Keywords: Carrier transport; Transparent conducting oxide; X-ray diffraction; Al-doped ZnO; Ga-doped ZnO; Magnetron sputtering; Ion plating

1. Introduction