

## Accepted Manuscript

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PII: S0040-6090(16)00159-0  
DOI: doi: [10.1016/j.tsf.2016.02.060](https://doi.org/10.1016/j.tsf.2016.02.060)  
Reference: TSF 35060

To appear in: *Thin Solid Films*

Received date: 7 October 2015  
Revised date: 28 January 2016  
Accepted date: 27 February 2016



Please cite this article as: J. Laube, D. Nübling, H. Beh, S. Gutsch, D. Hiller, M. Zacharias, Resistivity of atomic layer deposition grown ZnO: The influence of deposition temperature and post-annealing, *Thin Solid Films* (2016), doi: [10.1016/j.tsf.2016.02.060](https://doi.org/10.1016/j.tsf.2016.02.060)

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# Resistivity of ALD grown ZnO: The influence of deposition temperature and post-annealing

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Keywords: ALD, Zinc Oxide, Temperature Effect, Annealing Atmosphere

## Abstract

Conductive zinc oxide (ZnO) films deposited by atomic layer deposition were studied as function of post-annealing treatments. Effusion experiments were conducted on ZnO films deposited at different temperatures. The influence of different annealing atmospheres on the resistivity of the films was investigated and compared to reference samples. It was found that the influence of the deposition temperature on the resistivity is much higher than that of subsequent annealings. This leads to the conclusion that reduction of the resistivity by diffusion of different gases, such as oxygen and hydrogen, into annealed ZnO films is unlikely.

## 1. Introduction

Atomic layer deposition (ALD) of ZnO is a common method to prepare conformal ZnO thin films. (1) ZnO is thought to be an alternative to indium-tin-oxide as transparent electrical top contact for solar cell applications, thin film transistors, piezoelectric transducers and gas sensors. (2) (3) (4) ZnO has a wide band gap ( $E_g \sim 3.3$  eV at 300K) (5) (6) and offers low resistivities down to a few  $m\Omega\text{cm}$  (7) (8) (9) (10) which is sufficient as transparent conductive material. In principle two process parameters determine the film properties of the deposited ALD ZnO film: first the film thickness (11) and second the deposition temperature (12). Reports on post-treatments of ZnO are widely found (13) (14) (15), but up to now only few details are known about the influence of post-treatments in different ambients on the conductivity of ZnO.

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