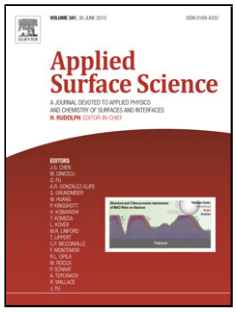

Title: Stability study: Transparent conducting oxides in chemically reactive plasmas

Authors: Krishna Nama Manjunatha, Shashi Paul

PII: S0169-4332(17)30855-3
DOI: http://dx.doi.org/doi:10.1016/j.apsusc.2017.03.173
Reference: APSUSC 35549

To appear in: *APSUSC*

Received date: 25-12-2016
Revised date: 12-3-2017
Accepted date: 20-3-2017

Please cite this article as: Krishna Nama Manjunatha, Shashi Paul, Stability study: Transparent conducting oxides in chemically reactive plasmas, Applied Surface Sciencehttp://dx.doi.org/10.1016/j.apsusc.2017.03.173

Stability study: Transparent conducting oxides in chemically reactive plasmas

Krishna Nama Manjunatha and Shashi Paul*

Emerging Technologies Research Center, De Montfort University, The Gateway, Leicester, LE18BH, United Kingdom

* Shashi Paul. Tel.: +44-116-207 8548; fax: +44-116-250 6049
E-mail address: spaul@dmu.ac.uk

Highlights

- *In-Situ* optical emission spectroscopy to diagnose the stability of ITO, FTO and AZO thin films.
- Improvement in the electrical and optical properties of AZO when exposed to Hydrogen plasma.
- Unexpected growth of silicon nanowires over chemically unstable ITO and FTO coated substrates.
- Extreme stability of AZO films towards higher temperatures and plasma conditions.
- AZO as an ideal transparent conductor for the fabrication on silicon nanowire solar cells.

Abstract

Effect of plasma treatment on transparent conductive oxides (TCOs) including indium-doped tin oxide (ITO), fluorine-doped tin oxide (FTO) and aluminium-doped zinc oxide (AZO) are discussed. Stability of electrical and optical properties of TCOs, when exposed to plasma species generated from gases such as hydrogen and silane, are studied extensively. ITO and FTO thin films are unstable and reduce to their counterparts such as Indium and Tin when subjected to plasma. On the other hand, AZO is not only stable but also shows superior electrical and optical properties. The stability of AZO makes it suitable for electronic applications, such as solar cells and transistors that are fabricated under plasma environment. TCOs exposed to plasma with different fabrication parameters are used in the fabrication of silicon nanowire solar cells. The performance of solar cells, which is mired by the plasma, fabricated on ITO and FTO is discussed with respect to plasma exposure parameters while showing the advantages of using chemically stable AZO as an ideal TCO for solar cells. Additionally, *in-situ* diagnostic tool (optical emission spectroscopy) is used to monitor the deposition process and damage caused to TCOs.

Keywords: Transparent conducting metal oxides; optical emission spectroscopy; silicon nanowires; solar cells; Stability of TCOs; reactive plasma.