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Highly moisture and weak-acid resistant Ga-doped ZnO films with titanium dioxide co-doping fabricated by magnetron sputtering

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Abstract

In this work, we proposed a strategy to improve the damp-heat stability and weak-acid resistance of gallium doped zinc oxide (GZO) thin films by co-doping TiO_2 into GZO targets. Results showed that GZO thin films with a 0.2 wt% TiO_2 co-doping in the target (GTZO) exhibited a resistivity of 5.1×10^{-4} Ω·cm and an average transmittance of 82.9 %. The relative change in sheet resistance was as low as 5.1% after 24 h damp heat treatment in conditions of 97% relative humidity at 121 °C. A craterlike textured surface with a high haze value was not found in GTZO thin films after dipping in 1 vol% HCl solution for 10 minutes. These results showed that GTZO thin films have great potential for use as transparent electrode in extreme outdoor conditions.

Keywords

Gallium-doped zinc oxide; Titanium dioxide co-doping; Moisture resistance; Weak-acid resistance; Magnetron sputtering; Thin films

1. Introduction

Transparent conductive oxide (TCO) thin films are widely used as a transparent electrode in organic light emitting diode, liquid crystal display, and solar cells due to excellent transparency in the visible light and high conductivity [1-4]. Generally, these optoelectronic devices need to undergo damp-heat (DH) and acid-mist tests before be used in harsh outdoor conditions [5,6]. Thus, it requires the transparent electrodes have excellent durability in extreme DH and acid-mist conditions. In most cases,