Cohesive strength of ZnO:Ga thin films deposited at room temperature

A.P. Samantilleke[1#], L. Rebouta[1*], , L. Rubio-Peña[2], S. Lanceros-Mendez[1], P. Alpuim[1], S. Carvalho[1]

1 Centro de Física, Universidade do Minho, Azurém, 4800-058 Guimarães, Portugal
2 University of Cadiz, Engineering School, C/ Chile, 1. 11002 Cádiz, Spain

Presenting author (anura@fisica.uminho.pt)

* Corresponding author (rebouta@fisica.uminho.pt)

Abstract

The main purpose of this work is the deposition of transparent conducting oxide (TCO) films on polymers with electromechanical and electro-optical properties, in order to develop applications such as flexible touch screens and keyboards. Transparent conducting ZnO:Ga (GZO) films have been deposited by dc magnetron sputtering, on glass, Polyethylene naphthalate (PEN) and poly (vinylidene fluoride) – (PVDF) substrates. Samples were prepared at room temperature while varying the working pressure. The deposition rate was approximately 30 nm/min and the thicknesses of films were between 100 and 700 nm. Electrical resistivity of 8.8×10^{-4} Ω.cm has been obtained for films deposited on glass, while a resistivity of 2.2×10^{-3} Ω.cm has been attained in similar coatings on polymers.

Tensile tests were performed in order to investigate the crack onset strain, the coating cohesive strength as well as the influence of mechanical strain on the electrical properties. The crack onset strain is similar for different GZO coatings and occurs for nominal strains around 1 %. The cohesive strength of coatings, which was evaluated from the initial part of the crack density evolution was found to be between 1.3 and 1.4 GPa. For these calculations, a Young´s modulus of 112 GPa, which was evaluated by nanoindentation using thick GZO films deposited on glass, was used.