

Electrochemical synthesis of ZnO thin film and nanowire for piezoelectric applications

H. Belkhalifa, N. Dokhan, A. Badidi-Bouda, R. Benzerga

Abstract : ZnO thin films and ZnO nanowire (NW) having piezoelectric qualities can be used in respectively SAW devices (Surface Acoustic Wave) and nanogenerators. In this work, we are interested in optimizing experimental conditions of ZnO electrodeposition to obtain thin films and nanowire with good piezoelectric performances. To achieve this goal, the ZnO thin films and nanowire must firstly present a good cristallinity with preferential orientation along (002) direction. Also, films electrodeposited must have good morphological properties (not porous and with insignificant surface rugosity), and NW must show good alignment and have direction of growth perpendicular to the substrate. The electrodeposition of ZnO was performed in a classical three electrodes electrochemical cell, under potentiostatic mode and at room temperature. The substrate was a molybdenum foil of 0.1 mm thick and with 99.95% purity. The electrolytic bath was initially composed of 5mM ZnCl₂, 5mM H₂O₂ and 100 mM KCl (supporting electrolyte), pH value being about 6.8. The initial conditions which give a well aligned of ZnO-NW (see fig. 1) were progressively modified in order to obtain a ZnO thin film. Samples were characterized by X-ray diffraction (XRD), scanning electron microscopy (SEM), energy dispersive X-ray analysis (EDX) and Electrochemical impedance spectroscopy (EIS), to obtain information about microstructure, morphology, composition and electronic properties of the films and nanostructures electrodeposited.

Keywords : ZnO, nanowires, thin film, electrodeposition, piezoelectric.