IN SITU XRD STUDIES, USING SYNCHROTRON RADIATION, OF THIN FILM GROWING BY REACTIVE SPUTTER MAGNETRON TECHNIQUE.

Jorge Feugeas*†[1], Juan Bürgi , Javier Garcia Molleja , Guinter Kellermann[2], Abdou Djouadi[3], Pierre-Yves Jouan[3], and Aldo Craievich*[4]

[1]Instituto de Fisica Rosario, CONICET-UNR (IFIR) – Bvrd. 27 de Febrero 210 Bis., 2000 Rosario, Argentina

[2]Universidad Federal do Parana, Parana, Brasil (UFP-Brasil) – Brazil

[3]Institute de Materiaux Jean Rouxel, Nantes, France (IMJR-France) – Institute de Materiaux Jean Rouxel, Nantes, France – France

[4]Universidad de São Paulo, São Paulo, Brasil (USP-Brasil) – Brazil

Abstract

In this work we present a reaction chamber for thin film deposition based on reactive sputter magnetron technique, specifically designed to be installed in the Huber goniometer in the XRD2 line of LNLS in Campinas, allowing in situ studies of the kinetic of thin films growing by the sequence of X-ray diffractograms.

The designed reactor allows for the control and precise variation of the relevant processing parameters. On the other hand, the chamber can be used in different X-ray diffraction scanning modes, namely

theta-2

theta scanning, fixed α-2

theta scanning and also low angle techniques such as grazing incidence small angle X-ray scattering and X-ray reflectivity. The chamber was mounted on a standard four circle diffractometer located in a synchrotron beam line and firstly used for a preliminary X-ray diffraction analysis of AlN (hcp wurtzitic crystal structure) thin films during their growth on the surface of a (100) silicon wafer.

Several kinetic have been done using DC discharges with a power of _˜6.4 W during 60 min., giving AlN films of _˜1 μm. In all cases, grazing incidence (α=2o) diffractograms have shown that the mains structure of the films are polycrystalline with crystals randomly orientated. On the other hand, with higher angle of incidence (α=18o) some privileged crystal orientations appears to be related with the working pressure and the N2/Ar gas concentration ratio. Nevertheless, kinetics has shown certain privileged crystal orientation variations during the deposition process. For 6.5x10-3 mbar and 1:3 N2/Ar ratio was possible to see the growing of (00.2) and (10.1) diffraction peaks during first 30 min. of process, time at which continuous to grows only the (10.1) one. On the other hand, the privileged crystal orientation could be modified during the deposition process. Indeed, when the processing conditions have been modified from 2.9x10-3 mbar of pressure and 1:1 N2/Ar gas concentrations ratio to 5.0 x10-3 mbar and 1:3, privileged crystal orientation have been shifted from (10.0) to (10.1).

*Speaker

†Corresponding author: feugeas@ifir-conicet.gov.ar

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