A comparison of software for the data analysis of combined X-ray reflectivity and grazing incidence X-ray fluorescence measurements

Bérenger Caby [(1)], Fabio Brigidi [(2)], Dieter Ingerle [(3)], Blanka Detlefs [(1)], Gaël Picot [(1)], Luca Lutterotti [(4)], Emmanuel Nolot [(1)], Giancarlo Pepponi [(2)], Cristina Streli [(3)], Magali Morales [(5)], Daniel Chateigner [(6)]

[(1)] CEA, LETI, MINATEC Campus, 17 rue des Martyrs, 38054 Grenoble Cedex 9, France
[(2)] MNF, CMM–Irst, Fondazione Bruno Kessler, Via Sommarive 18, 38123 Povo, Trento, Italy
[(3)] Atominstitut, Vienna University of Technology , 1020 , Vienna , Austria
[(4)] Dpt. of Industrial Engineering, University of Trento, via Sommarive 9, 38123 Povo, Trento, Italy
[(5)] CIMAP , 6 boulevard du Maréchal Juin , 14050 Caen Cedex 4, France
[(6)] CRISMAT-Ensicaen, IUT-Caen UCBN, 6 boulevard du Maréchal Juin, 14050 Caen Cedex 4, France

X-ray reflectivity (XRR) is a non-destructive, highly accurate method for the characterization of multi-layered structures by providing information on the thickness, the roughness and the in-depth electronic density. Angle-dependent grazing incidence X-ray fluorescence (GIXRF) provides information about the elemental depth distribution and has been widely used to investigate thin films on substrate [1]. As these techniques are based on similar measurement procedures and data evaluation approaches, their combination reduces the uncertainties of the individual techniques and provides an accurate depth-resolving analysis of multilayers [2]. Several software have recently been developed to perform the combined modeling of XRR and GIXRF.

Our study focuses on the comparison of four combined XRR and GIXRF data analysis software (Maud [3], jGixa [4], Gimpy and MedePy). For each software, the representation of the layers and the stack, the database used, the formalism implemented, the data reduction algorithms as well as the method to correct the effect of the geometrical factor on the measured angle-dependent fluorescence intensity has been described and compared. Indeed, as the GIXRF signals depend on experimental setup parameters, a geometrical factor has to be calculated when comparing theoretical calculations and experimental data [5]. The influence of multiple experimental parameters on the refinement agreement have also been evaluated.

Each XRR and GIXRF combined fitting methods have been compared with respect to their performance in diverse situations using simulated data (Figures 1 and 2), and using experimental data acquired on a Ni (50nm)/SiO_2/Si sample measured on a laboratory tool equipped with a Molybdenum tube.

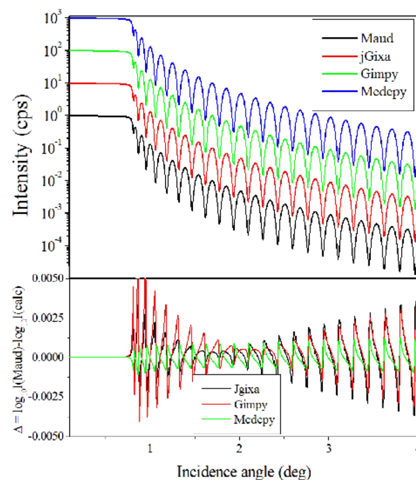

Fig. 1 : XRR simulation software comparison

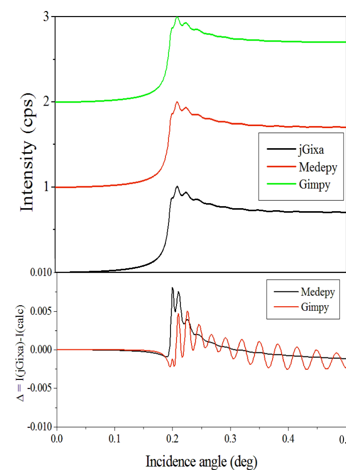

Fig. 2 : GIXRF simulation software comparison

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