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Newsletter

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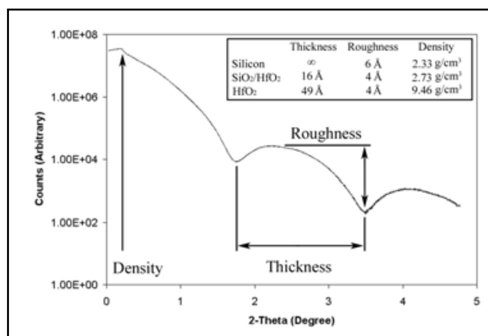
X-ray reflectivity:
a new technique for thin film measurements

By V. Craciun

The X'Pert MRD is an excellent tool for the measurement of the x-ray reflectivity (XRR) of thin films. A specially designed high intensity x-ray tube in combination with cutting edge optical components results in an incident beam of 3.0×10^7 counts/s with a remarkably low divergence of 0.003°. The X'Pert MRD system allows for the generation of high-resolution XRR spectra of thin films deposited on a variety of substrates over a range of 0.1 – 7°. Sample alignment can be completed in only 30 min with a one-hour acquisition time for a high resolution XRR spectrum. A typical XRR spectrum acquired from a thin film of HfO_2 deposited on Si by laser ablation is shown in the figure below. The acquired spectrum has been modeled using the Philips Wingixa software package. Features of the XRR spectrum such as the critical angle, periodicity of oscillation and their amplitude are directly related to the density, thickness and roughness of the actual structure. Example results obtained from modeling are displayed in the inset below.
To date, Dr. Rajiv Singh's group has been the major user of this technique allowing them to characterize the thickness and properties of high-k dielectric layers deposited on Si [1, 2]. To find out more about XRR please contact Dr. V. Craciun at vcrac@mse.ufl.edu.



1. J. M. Howard et al., in press, Appl. Phys. Lett. **82** (18), (2002)

2. N. D. Bassim et al., in press, Appl. Surf. Sci. (2002)

Typical XRR spectra of HfO_2 thin film with modeled data shown in inset

Director's Corner *by L.A. Dempere*

A significant number of graduate students registered for the course Scanning Electron Microscopy in the Fall 2002. Thus, it was necessary to open 35 lab sessions to provide training on the JSM-35CF. These lab sessions are being taught by MAIC's staff, graduate research assistants and volunteers. I would like to thank all the lab assistants for their help teaching these labs, especially those that are volunteering their time at the MAIC. This course is a pre-requisite for an advanced SEM course to be offered in the near future. Training in the Ultracryomicrotome Ultracut UCT from Leica is now available. Training is provided using glass knives. Please, contact MAIC for information of training and service using diamond knives.

MAIC web page: http://mse.ufl.edu/~maic/ E-mail: maic@mse.ufl.edu

Dr. Valentin Craciun
XRD and Associated Techniques

Dr. Valentin Craciun has joined the faculty of the MAIC in the area of X-ray Diffraction and associated techniques. He earned his Ph.D. in technical physics at the Polytechnic University Bucharest in Romania conducting laser surface studies for microelectronics applications. He was then a research fellow at the University College London where he studied the pulsed laser deposition of oxide films and UV-assisted low temperature oxidation of semiconductors.

Valentin also worked as a visiting scientist at the University of Orleans, France, where he investigated the role of laser plasmas for thin films processing. Eventually, he returned to Bucharest as a senior researcher at the National Institute for Laser, Plasma, and Radiation Physics. In 1998, he became a visiting scholar at UF in the group led by Dr. Rajiv Singh. Valentin has co-authored more than 100 scientific journal articles and communications, presented eight invited talks, chaired sessions at European Materials Research Society (E-MRS) meetings and served on the scientific committee of several conferences. He has been a referee for Applied Physics Letters, Journal of Applied Physics, Thin Solid Films, Journal of Materials Research, and several other journals.

In June 2002, Valentin co-organized the E-MRS Symposium on Physics and Chemistry of Advanced Laser Materials Processing. In 2003, he is co-organizing a NATO-Advanced Study Institute on laser processing of biological tissues and biocompatible materials.

At MAIC, he is teaching a class this fall on the use of x-ray diffraction techniques for thin films analysis and plans to teach an advanced class for the characterization of epitaxial films (high resolution rocking curves, pole figures, phi scans, space maps) next semester. His future plans include collaboration with faculty members who grow and process thin films and, together with colleagues from MAIC, the preparation of a new class about the metrology of nanometer-thin films and structures.

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Spring 2003 Courses
Special Research Techniques

The topics to be covered by the Specialized Research Techniques in Materials Science, course EMA 6919L (2 Credits), in the Spring 2003 are: X-Ray Photoelectron Spectroscopy (XPS)(Instructor: Eric Lambers) and the **new course** X-ray characterization of epitaxial films (Instructor: Dr. Valentin Craciun). Both courses include theory and training. Training on XPS will be on the PHI 5100 ESCA system and the Kratos ESCA XSAM 800. Training of XRD course will be on the Phillips X'Pert MRD diffractometer.

Conferences 2002-2003

The Microscopy and Microanalysis 2002 meeting this year was hosted by the Microscopy Society of Canada in Quebec City, Canada. This conference was jointly sponsored by the Microscopy Society of America (MSA), the Microbeam Analysis Society (MAS) and the International Metallographic Society. MAIC was represented at this conference with a poster entitled *"Characterization of the effects of particle size on the microstructure of* $MoSi_2$-TiB_2 *composites produced by elemental in-situ reactions using SEM and EPMA"*.

Microscopy and Microanalysis 2003 will be held in San Antonio, Texas on August 2003 jointly with the meeting of Committee of Inter-American Societies for Electron Microscopy (CIASEM).

The 2003 Annual Symposium of the Florida Chapter of the American Vacuum Society and the Florida Society for Microscopy will take place on March 17-18, 2003 at the Student Union Building of the University of Central Florida in Orlando. The deadline for abstract submission will be announced soon. The symposium will include technical sessions, a student poster competition, short courses and equipment exhibit with local and national vendors.

The MAIC welcomes
Lennox Industries, Inc.
as a new industrial/commercial user of the MAIC facilities and Dr. S. K. Hong from Civil and Environmental Engineering at the University of Central Florida

MAIC POLICIES CORNER: *Using MAIC facilities after hours*

MAIC facilities can be used after hours and weekends by qualified/authorized users of the MAIC instrumentation. We recommend students do not work alone in the building. Also, do not unlock building access doors after hours or weekends. Report any suspicious activity as soon as possible. For more information on safety and security rules, the student guide for campus safety & security can be found at: http://www.dso.ufl.edu/stg/Police_Services.html