In situ Studies of Materials Processing Workshop

May 22, 2002

A workshop titled "In situ studies of materials processing" included speakers using synchrotron-based x-ray techniques to study materials processes and speakers outside the synchrotron community.

Physicist Randy Headrick, of the University of Vermont in Burlington, kicked off the workshop with an overview of in situ studies of materials processing. He outlined the information that can be obtained with

Workshop Participants

different synchrotron-based surface x-ray techniques and assessed the potential of X21 for such studies in the future.

Physicist Christian Lavoie, from the IBM Research Division's Thomas J. Watson Research Center in Yorktown Heights in New York, showed how the use of real-time synchrotron light can dramatically reduce the time necessary to investigate the physical properties and transformations in a wide range of cobalt alloy silicides.

Materials scientist Kit Umbach, of Cornell University in Ithaca, New York, showed how Grazing-Incidence Small-Angle X-ray Scattering (GISAXS) had enabled him to follow carefully the formation of ripple patterns on silicon dioxide during sputter erosion with argon ion beams. His results suggest that the finite viscosity of the surface plays an important role in determining the surface morphology.

This work contrasted with that of materials scientist George Malliaras, of Cornell University, who is developing pentacene-based optoelectronic materials. His initial Atomic Force Microscopy (AFM) and x-ray scattering results with Headrick suggest that there is an unusual structure in the first layer of pentacene deposited onto silicon, and that 3-d crystallites nucleate on top of that layer. One of the most powerful surface x-ray techniques is surface crystallography, but its effective utilization requires solving the well-known phase problem.

Physicist Paul Lyman, of the University of Wisconsin in Milwaukee, showed that, to some extent, this problem could be overcome by using maximum entropy methods.

The last three talks dealt with very important materials processes for which real-time x-ray scattering may be able to provide vital information.

Physicist R.D. Vispute, of the University of Maryland in College Park, discussed the extensive Pulsed-Laser Deposition (PLD) growth efforts at the University of Maryland, focusing particularly on efforts to develop aluminum nitride dielectric layers for use on silicon carbide-based devices and to develop wide-bandgap semiconducting zinc-oxide/manganese oxide alloys for UV detectors.

Physicist Eleftherios Iliopoulos, of Boston University, discussed Molecular Beam Epitaxy (MBE) growth of III-V nitride films, particularly alloys of gallium-nitride with aluminum-nitride and indium-nitride.

Finally, materials scientist Karl Ludwig, of Boston University, made a brief presentation on behalf of materials scientist Charles Eddy, from the Naval Research Laboratory (NRL) in Washington, DC, who was unable to attend the workshop. Eddy reviewed plasma processing and showed that, while much has been learned about the chemistry of the plasma and the gas above the processed surface, relatively little is known about the actual structure of the surface itself. In this case, as in many examples presented throughout the workshop, the new real-time facilities being planned at the NSLS would provide many opportunities for enhancing our understanding of fundamental materials processes.

-Karl Ludwig, Randy Headrick, and Chi-Chang Kao