New X-Ray Diffractometer in the Department of Mechanical Engineering at the U of R

The Materials Science Program in the Department of Mechanical Engineering has recently opened an x-ray analysis laboratory with two **Philips** x-ray diffractometers. The instrumentation was funded from National Science Foundation, Division of Materials Research and the U of R with equipment help from Bausch & Lomb and Philips Analytical. The total value of this facility is about $478,000. The Materials Research Diffractometer, MRD, is well suited for very high-resolution work especially for thin films and single crystal multilayer diffraction analysis; the Multi Purpose Diffractometer, MPD, is for powder or polycrystalline diffraction analysis at room or non-ambient temperatures. These instruments have a wide range of applications: high resolution rocking curves for electronic wafers, quantifying defects and perfection in high quality crystals, measuring thin film thickness, layer densities and interface quality. In bulk and thin film materials, one can determine stresses, textures and grain sizes, and perform qualitative and quantitative analysis of powder diffraction data. This is made possible by pre-aligned, interchangeable x-ray optical modules for pre and post processing of the x-ray beam. The user can select from a variety of Prefix optics, depending on his/her requirements for intensity, focusing and tolerance for beam divergence. These modules can be exchanged in a matter of minutes, without the need for complicated dismantling, reassembly and realignment. Generally, higher intensity is accompanied with increased beam divergence. For example, an asymmetric crystal module, using a Ge (220) 4 crystal monochromator supplies Cu $K\alpha_1$ radiation at a beam divergence as low as 18 arc-seconds and an intensity of 5 million counts per second. The line and spot foci have intensity 100 times higher, but at the expense of an increased beam divergence. The new goniometer has a resolution on θ and 2θ of 0.0001°. The Eulerian cradle has 5 degrees of freedom for sample orientation and position. The x-ray software is extensive with functions for performing standard computations, crystal orientations and analysis, textures, residual stresses, particle size analysis, film thickness, comparison of the diffraction pattern with known patterns, etc. The results obtained on complex structures are precise yet very fast. The data can be exported to spread sheets and other graphical programs. The instruments are housed in the refurbished x-ray room in Hopeman 111 on River Campus. Presently, both diffractometers are using exactly the same software so they are operationally transparent. The MPD and MRD units including the very high resolution modules and goniometer are going to be used in selected Mechanical Engineering and Materials Science courses starting Fall 2000. For further information about the instruments and their capabilities, Professor Stephen Burns may be contacted by phone at (716) 275-4082 or he can be reached by e-mail, burns@me.rochester.edu. Chris Pratt schedules operation and use. Her e-mail is Pratt@me.rochester.edu or call (716) 275-7807.

X-Ray Optics for Selected Applications in Materials