

# Carnegie Mellon

## Materials Science and Engineering Seminar Series

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Columbia University

*“Measuring Particle Size with X-Ray Diffraction”*

**Friday, April 3, 2009**

**11:30AM Seminar in Baker Hall 136A**

Using X-ray diffraction to measure the thickness of scattering regions is a popular and accepted technique. In addition to the time-honored Scherrer Equation, there are five other methods of analyzing x-ray scattering data to get the domain thickness. A critical reader of literature might note that there have been no studies where all of these techniques were applied to the same sample. In this seminar we will review the basic theory of x-ray diffraction, and then analyze high-resolution X-ray diffraction (HRXRD) data using the Scherrer equation, rocking-curve modeling, thickness fringe analysis, Fourier analysis, and the Warren-Averbach method. We will then compare our results with cross-sectional transmission electron microscopy and X-ray reflectivity obtained from the same samples. Our results show that, for an ideal sample the absolute accuracy of thickness obtained from HRXRD data is approximately 1 nm (if all sources of broadening are correctly identified), while the precision is one or two orders of magnitude smaller. Unfortunately, there can be significant uncertainty in the results if the samples are not ideal.

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I. C. Noyan has been working on characterization and modeling of mechanical and micromechanical deformation using diffraction techniques for the past thirty years or so. He has worked with samples ranging in size from microchips to suspension-bridge cables. Prior to joining Columbia University full-time in 2004, he worked at the IBM T. J. Watson Research Center where he headed the microbeam diffraction effort and its application to integrated circuit reliability. He is a Fellow of American Physical Society.