

**PURDUE SCANNING PROBE MICROSCOPY USERS GROUP SEMINAR**

**DR. DONAND A. CHERNOFF**  
*Advanced Surface Microscopy, Inc.*

**FRIDAY, APRIL 3, 2009**  
**11:30AM, BRK 2001**

**“Picometer-Scale Accuracy in Pitch Measurements using Microscopes”**

This presentation discusses some metrology requirements of the optical and magnetic data storage industries. Current and new media formats require nanometer control of track pitch and feature size variation. Nanometer control implies picometer metrology. We use an ordinary open-loop AFM with additional offline calibration and measurement software to measure pitch and pitch variation. On a 144 nm pitch 2-Dimensional square grating, we measured average pitch to an accuracy of 40 pm ( $1\sigma$ ). Accuracy was confirmed by optical diffraction measurements at a national standards laboratory (PTB). We discuss the traceability path, showing how diffraction and microscopy work together to provide surprisingly low uncertainty. Our analysis method also works with SEM images. Measurements of a 35 nm pitch 2-dimensional grating showed individual pitch variation of 80 pm ( $1\sigma$ ). This precision suggests one could measure the average pitch to an accuracy of 10 pm ( $1\sigma$ ), thereby providing a very useful traceable standard. We also report pattern angle and skewness with resolution better than  $0.1^\circ$ . We describe a plan for certifying traceable pitch standards down to 10 nm pitch. This would support coming requirements in semiconductor and hard disk manufacturing.

**Don Chernoff** is a leader in AFM and SEM analysis. His process to accurately measure the size, shape and position of features in AFM and SEM images is in use worldwide. It helped make DVD possible and it supports more than half the world's production of DVD and Blu-Ray discs. He discovered that phase imaging in Atomic Force Microscopy provides important and useful contrast between material domains on surfaces, another technique used worldwide. Earlier, he worked in laser spectroscopy, optics and electron microscopy. He has over 25 years of industrial research and engineering experience, including 8 years at BP America, 2 years at Roche Diagnostics, and, since 1990, at Advanced Surface Microscopy, Inc., where he specializes in practical applications of AFM to solve processing and materials problems. Since 1990, Don and his colleagues have done more than 1000 AFM analysis projects for more than 200 customers involving more than 100 different kinds of materials and devices. Don was educated at the University of Chicago (B.S. Chemistry 1973, Ph.D. Physical Chemistry 1978). He has over 40 publications and 2 patents. Don has been an invited speaker at many national and international conferences, including Nanotech, Replitech, IDEMA hard disk technical conference, Pittcon and American Society of Materials.

Don's research interests are very broad, being defined only by whether a given material or device can be touched by an AFM probe. For example, he has studied: Superpolished surfaces such as silicon wafers, Polymers used as food wrappers, Nanoparticles on drug microspheres, Nanoscale drug particles, DNA and peptide complexes with DNA, Optical disks, Magnetic disks and recording heads, Paper, and Decorations used for greeting cards

Contact information:

Don Chernoff, Advanced Surface Microscopy, Inc., Indianapolis IN  
donc@asmicro.com  
www.asmicro.com