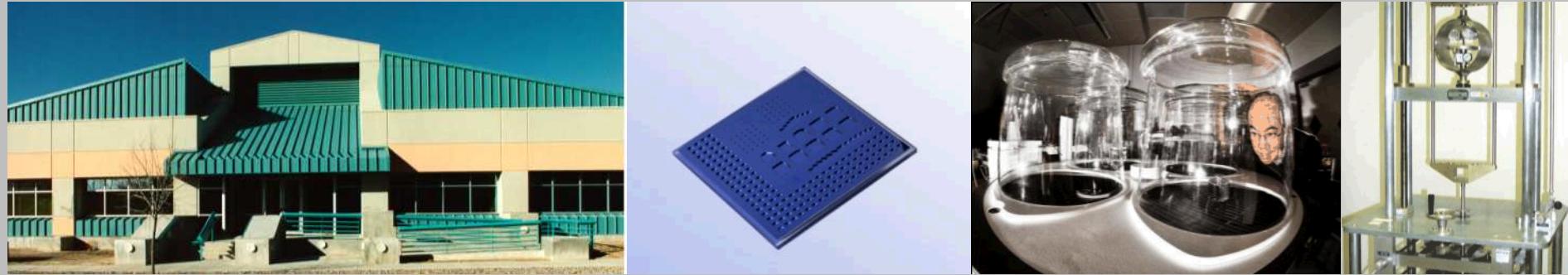


Exceptional service in the national interest



Measurement of Surface Topography: Comparison of Interferometry and Stylus Methods

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US Air Force Academy
Squadron 13
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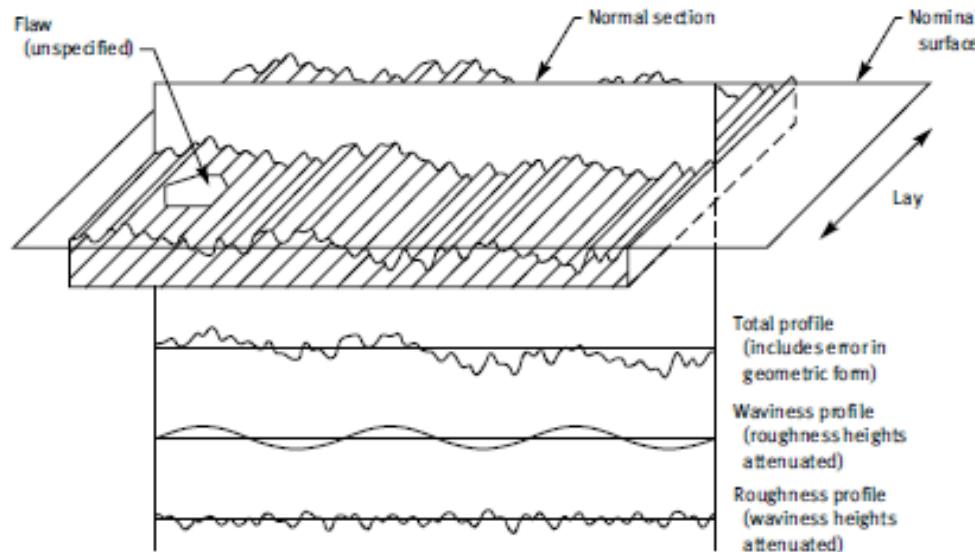
Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Outline

- What is surface metrology? Why is it important?
- How is it measured?
- How did this project impact surface metrology at Sandia and NNSA?

Surface Metrology

- Study of Surface Texture
 - Roughness, Waviness, and Lay
- Applications
 - Wear
 - Corrosion
 - O-ring seals
 - Conductivity



Measurement

- Contact
 - Stylus
 - Advantages
 - Non-Homogenous material is unimportant
 - Very consistent
 - Weaknesses
 - Can't be used on soft materials
 - Scanning more than one line is slow
- Non-Contact
 - Confocal Microscopes
 - Interferometry
 - Phase-Shifting
 - White Light
 - Advantages
 - Full aerial picture
 - Can measure soft materials
 - Measures quickly
 - Weaknesses
 - Non-Homogenous materials and transparent films create errors



Interferometry

- Length measurement using light interference
 - Fringe patterns change as distance to the sample changes
 - Coherent peak at a distance equal to the reference mirror

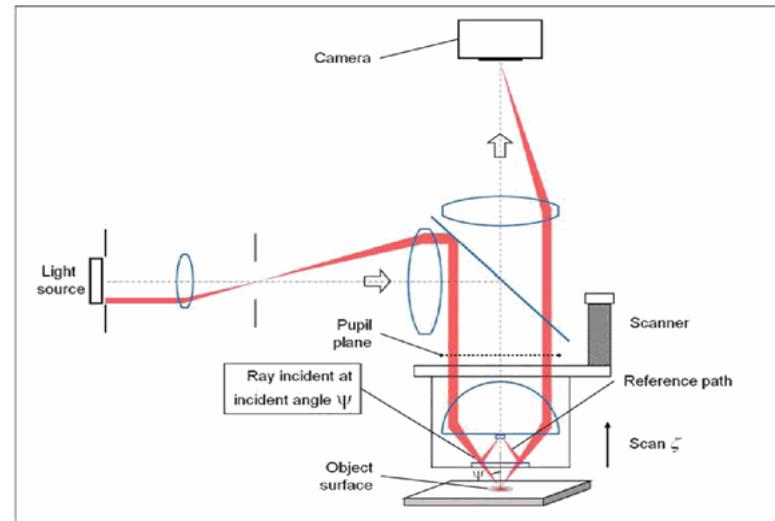
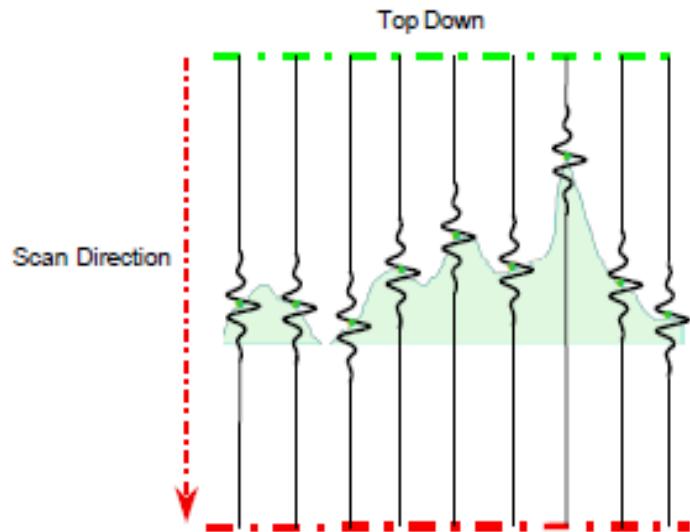
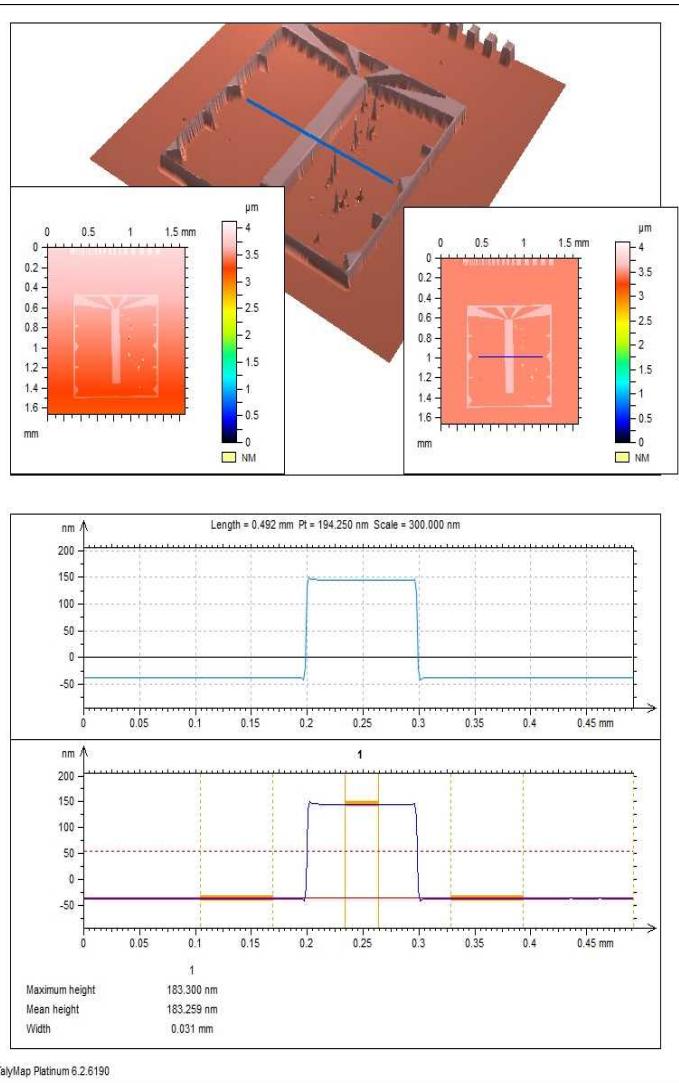


Fig. 9.4 Path of a single ray bundle through a CSI instrument

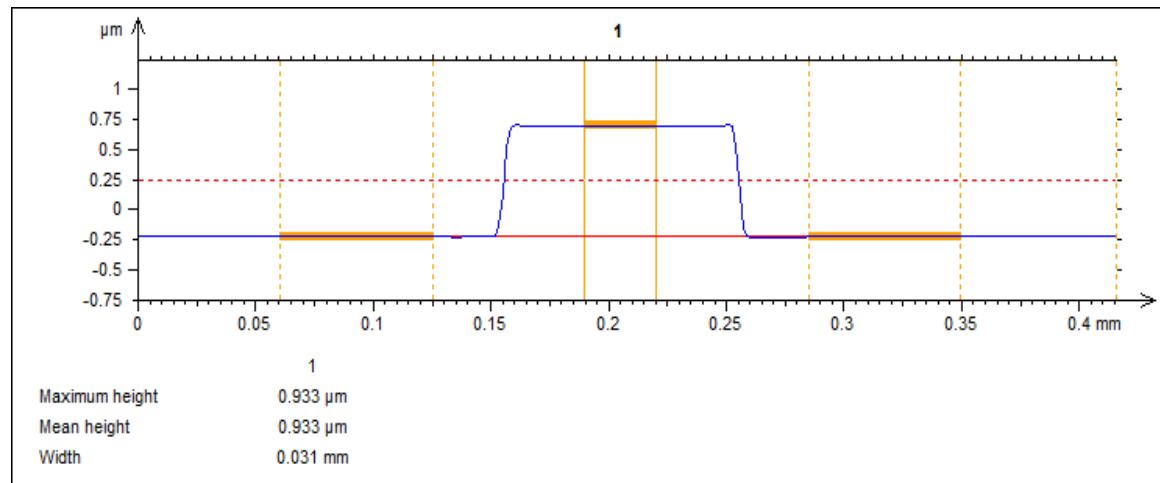
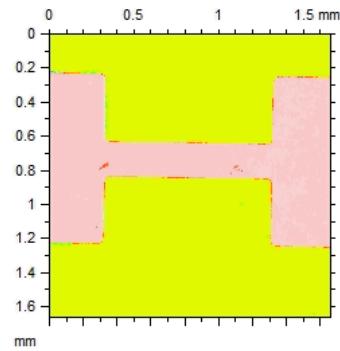
Task

- Qualify the CCI-Lite interferometer
 - Establish a calibration procedure
 - Collect info to calculate uncertainties
- Test it against stylus machines
 - Homogenous, non-homogenous, and film-coated samples



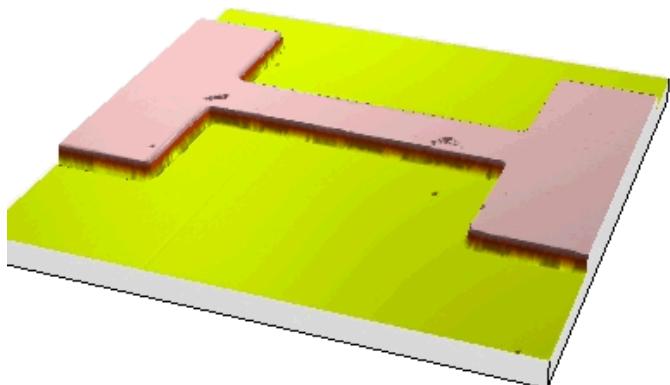
Impact

- Qualify this machine to be used by the lab
 - Reduce the uncertainty of measurements by an order of magnitude
 - Increases speed at which measurements can be taken
- Understand the limitations of the machine
 - Different materials
 - Transparent films
- Ultimately gives this lab an increased ability to support Sandia and NW enterprise
 - Calibrating reference standards for Y12, KCP, Pantex
 - Sandia support includes
 - Neutron Generators
 - Microsystems



What I learned

- How metrology works
 - How various machines are used to measure different fundamental properties
 - The importance of environmental control
- The importance of statistics in research
 - Repeatability
 - Uncertainty
- How laboratories are actually run



My time in Albuquerque

- Hiking
 - Bandelier
 - Sandia Mountains
 - Tent Rocks
- Kayaking the Rio Grande
- Food and Drink
 - Microbreweries
 - Wineries
 - New Mexican Food
- Santa Fe
- Old Town
- Natural History Museum
- Tram



Questions?

*If we knew what we were doing, it wouldn't be
called research.*
-Albert Einstein