Auburn University

Innovation Advancement & Commercialization

Optical Sensor for Quality Control of Reflective Surfaces

Contact

Brian Wright
Auburn University
Innovation Advancement
& Commercialization
334-844-4977
brian.wright@auburn.edu
https://iac.auburn.edu/
Reference: Quality Control for Reflective Surfaces

Inventors

Hareesh Tippur
Professor
Mechanical Engineering

Chandru Periasamy
Graduate Student
Mechanical Engineering

Status

- A functional prototype has been demonstrated on a polished silicon wafer
- Subject of U.S. Patent 9,759,553, and a pending continuation (20170336197)
- Periasamy and Tippur, 2013, *Meas. Sci. Technol.* **24:** 025202. (link)

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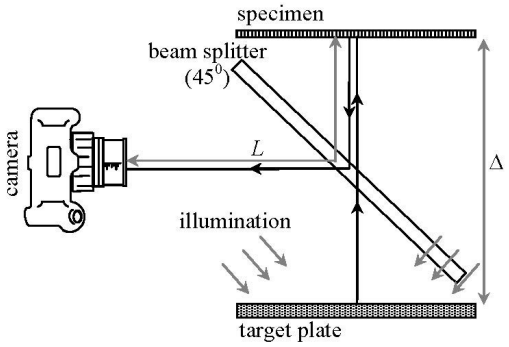
Overview

Auburn University is seeking a licensee or development partner for an optical sensor and visualization tool for slope, curvature, and topography measurements. This sensor is designed for thin reflective films and reflective structures such as mirrors and silicon wafers. While surface slopes can be used to evaluate flatness, curvature components can be used to quantify stresses. This technology is also capable of detecting localized defects and anomalies on reflective surfaces. This enables the user to detect otherwise imperceptible flaws. The technology is relatively cost effective and easy to implement and automate. Applications of this sensor can be expanded for surfaces that are reflective outside the visible spectrum, such as infrared.

Advantages



- Optical sensing: This can help identify flaws over the entire field of view that cannot be found through visual inspection.
- Non-destructive analysis: Measurements can be made without contacting specimen.
- Simple setup: Only requirements are a digital camera, image analysis software, and minimal other standard equipment.
- Inexpensive and easy to use: Simple set up requires limited expertise to operate.
- Rapid results: Can perform real-time analysis; evolution of surface slopes have been visualized during thin-film polymerization on silicon substrates.
- Highly sensitive: Surface slopes on the order of 0.00001 radians have been measured.

Description

Thin structures subjected to stresses are frequently encountered in many aerospace and electronic systems. Further, fabrication of electronic and MEMS devices often require quantitative evaluation of substrate and thin film flatness in terms of slopes and curves. For example, silicon wafers that are coated / deposited with thin films introduce thermal and/or mechanical stresses in addition to those caused during manufacturing and service. In such situations, quantification of surface characteristics such as deflection, slope and curvature become important.

If not discovered, minuscule deformations can induce poor performance and premature failures for the end user. The high sensitivity of this optical device is capable of identifying defects on a surface that would otherwise go undetected. Follow-on data analysis can obtain detailed topography of measured surfaces. Being able to identify areas of stress and deformity through such analyses can also improve the quality, durability, and overall performance. In applications such as the microelectronics industry, surface stress and deformation can be an invaluable tool in reducing time and costs and improving quality control.

The device uses a simple combination of a digital camera, light source, beam splitter and reference target. Image correlation is then used to measure angular deflection of light rays.

Licensing Opportunities

- This technology is available for exclusive or non-exclusive licensing
- Joint development opportunities include funded research or a joint venture