Juan J. Faria-Briceno, S.R.J. Brueck

Electrical and Computer Engineering Department and Center for High Technology Materials,
University of New Mexico, Albuquerque, New Mexico 87106

Introduction

Roughly 20% of the processes in high-volume IC fabrication focus on metrology. New fabrication techniques such as roll-to-roll (R2R) processes are being developed for manufacturing large-area nanotechnology products such as wire-grid polarizers (WGP), metal-mesh grids, and metamaterials. Angular Scatterometry has demonstrated noncontact, optical capabilities for characterizing WGP and photoresist structures with sub-100 nm dimensions, with simulations extending to ~ 10 nm. This work focuses on closing the gap between new fabrication processes: Roll-to-Roll/Roll-to-Sheet (R2R/R2S), and metrology/inspection systems capable of characterizing samples (flat, 1D, 2D, and 3D) in real-time during advanced nanomanufacturing. R2R and R2S are advanced new, low-cost, high-volume manufacturing approaches to nanoscale features. Due to the dynamic conditions during production, real-time, in-line metrology/inspection processes are fundamental to ensuring yield and production efficiency. Our technology is non-contact, non-destructive and can be applied to any R2R/R2S fabrication system and has demonstrated nanoscale resolution at web speeds up to 320 cm/s.

Project Description

This sweeping process will allow rapid scanning of defects by collecting the defect refection signature variations. The reflectivity variations will allow the system to characterize defects size and types (non-filling, pinholes, striations, etc.). Fig. 3. a) presents a relatively large non-filling defect (~50 µm; the kerf region). b) The spike shown on the scope represent the signal detection from the beam sweeping across the defect. An advantage of the position sweeping this that the defect shows up as a rapid change in the reflectivity which detected with simple electronic filtering. The sensitivity to defects will depend on both the change in the reflectivity parameters for the defect as compared with the filled region, and the size of the defect. Simply from the example shown in FIG. 3, the signal to noise (S/N) is about 10 as the defect is scanned. This suggests that defects of ~ 5 mm in the direction of the web motion will be readily detected. With additional signal processing, this scale can be reduced to sub-micrometer scales.

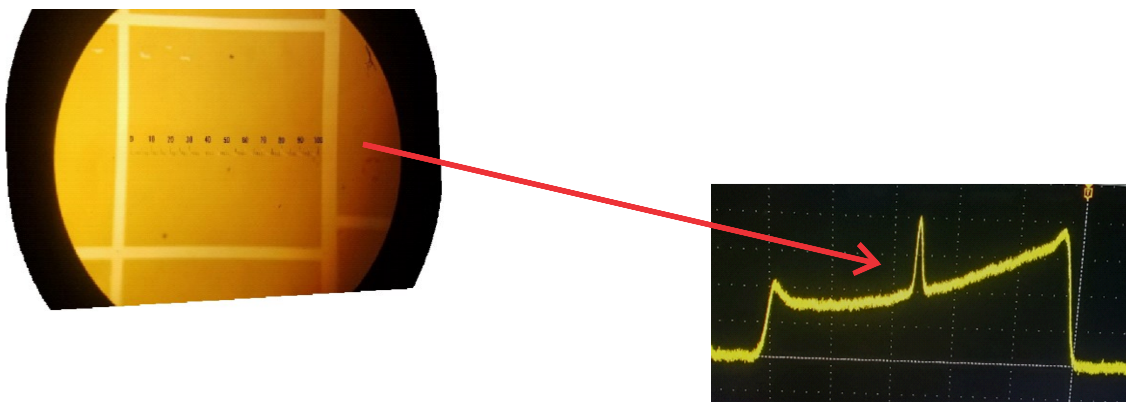

Fig. 1: Observation of a defect during an in-line optical scatterometry measurement as the optical beam is swept across a 50 mm wide non-filling defect.