

Thin Film Measurement solution
Software, sensors, custom development and integration

Optical Endpoint Monitoring for CMP

Broadband Spectral Reflectometry Endpoint Detection

System Components

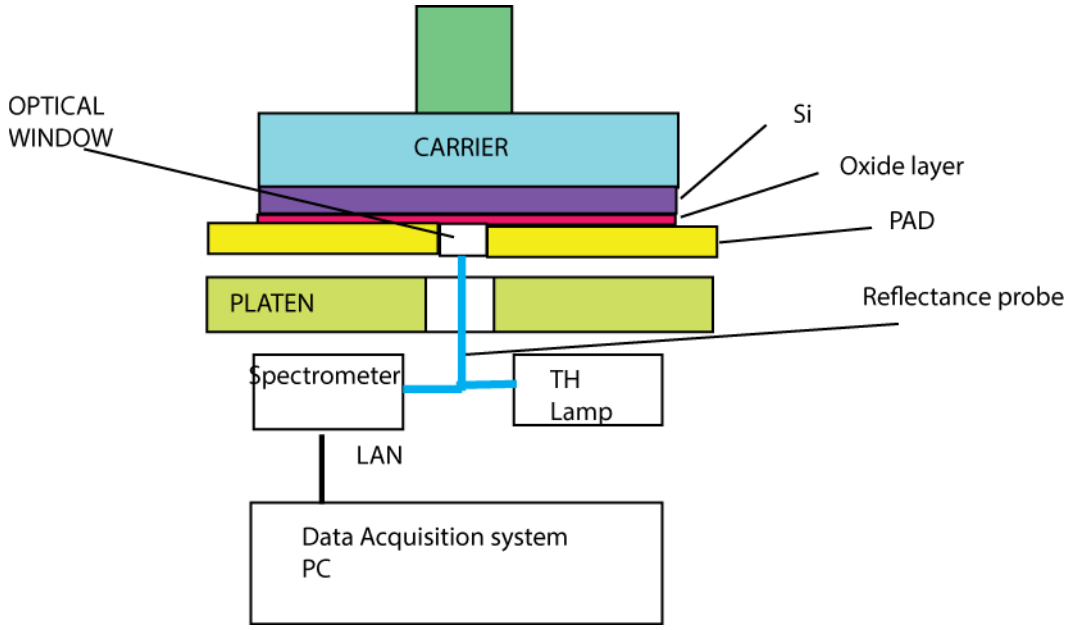
- Broadband illumination source (5 W Tungsten-Halogen lamp, 10 000 hr lifetime)
- Fiber-coupled spectrometer:
  Ariel VIS Spectrometer
- Optical probe integrated under CMP platen
- Through-pad optical window
- Real-time spectral analysis software
- Tool interface via **Modbus TCP server**
- Integration via **DLL API library**

Purpose:

- Real-time monitoring of **oxide/dielectric layer thickness during CMP**
- Reliable endpoint detection

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Measurement Principle



Measurement Geometry

Light path:

1. Broadband light from **TH lamp**
2. Coupled into **illumination fiber**
3. Delivered through **optical port under platen**
4. Passes through **transparent window in polishing pad**
5. Reflects from wafer surface
6. Collected by **collection fiber**
7. Sent to **Ariel VIS spectrometer**
8. Spectrum processed in real time

Key characteristics

- Measurement occurs **each time wafer passes over the window**
- Broadband spectral reflectance recorded
- Film thickness extracted from reflectance spectra analysis

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Optical Signal During Oxide CMP

Typical signal behavior:

During oxide removal

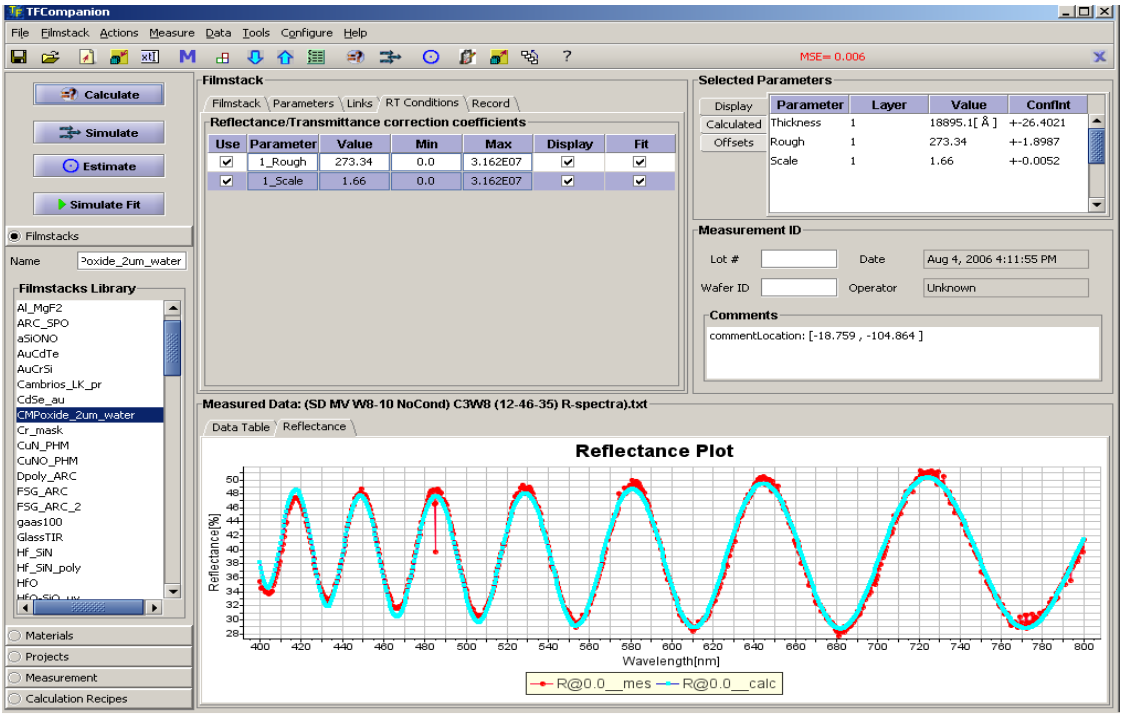
- Interference fringes shift as oxide thickness decreases
- Reflectance oscillates smoothly

At endpoint

- Oxide cleared → silicon exposed (or another layer, like SiN is exposed)
- Spectral signature changes abruptly
- Endpoint detected automatically

Advantages of spectral method:

- Robust against slurry scattering
- Works with oxide thickness from ~20 nm to up to 100 µm
- High sensitivity



Typical Oxide measurement (model to measurement fit). Preparation of the filmstack before production run (adjusting the dispersion of the material)

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Hardware Architecture

Light Source

- 5 W Tungsten-Halogen broadband lamp
- Lifetime: **10 000 hours**
- Stable spectral output
- Fiber-coupled illumination

Spectrometer

Ariel VIS Spectrometer

Key characteristics:

- Wavelength range: **400-1000 nm**
- High optical throughput – astigmatism corrected
- Fast acquisition for rotating wafer
- Fiber optic interface
- Compact integration

Typical acquisition speed:

- **millisecond-scale spectra**

Suitable for:

- Real-time CMP monitoring
- Spectral reflectometry
- Thin film endpoint detection

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Optical Probe Configuration

Components under platen:

- Illumination fiber
- Collection fiber
- Optical lens assembly
- Sapphire / quartz **pad window**

Design goals:

- High signal-to-noise ratio
- Minimal slurry interference
- Stable measurement geometry

Typical optical parameters:

Parameter	**Typical Value**
Spot size	< 1 mm
Measurement angle:	near normal
Collection NA	matched to fiber (0.22)
Sampling rate	each platen rotation (acquisition is synchronized)

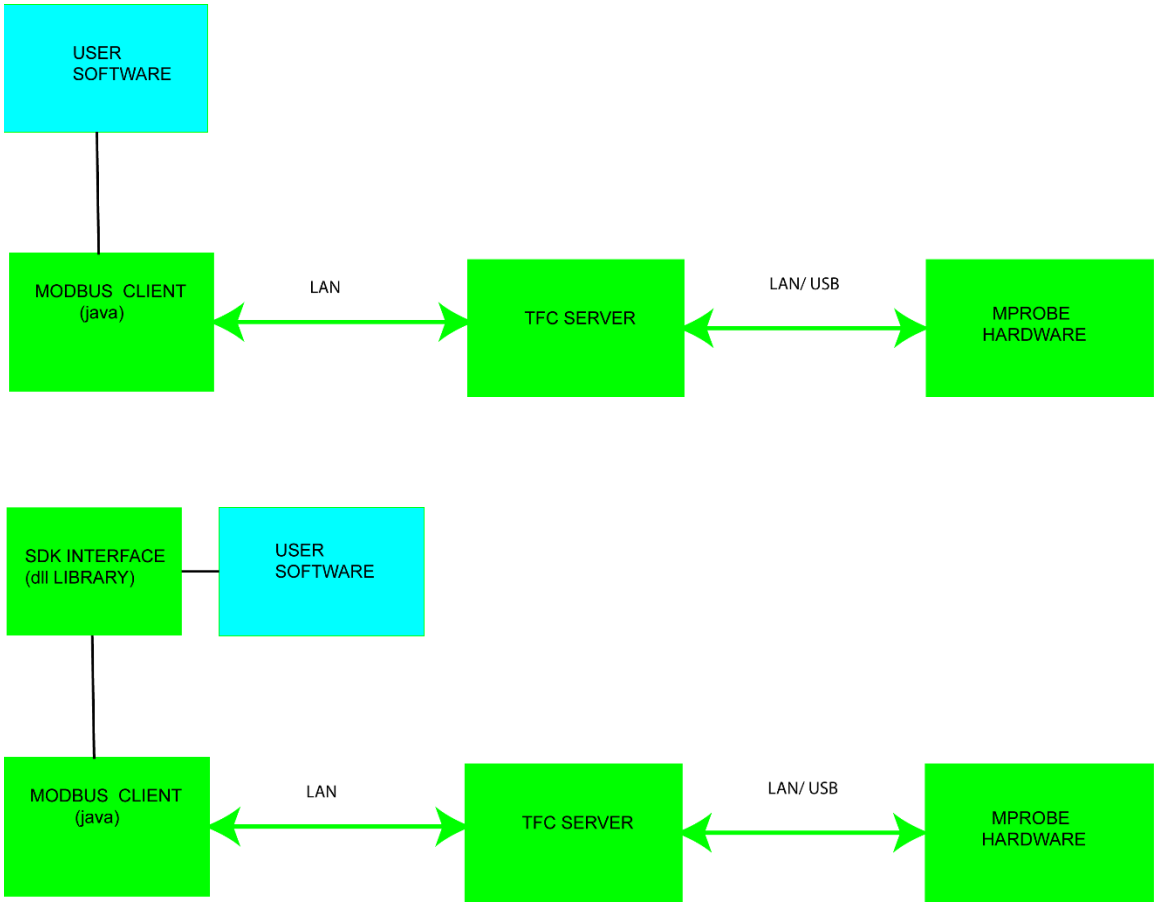
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Software Architecture

Real-time control software

Functions:

- Spectrometer control
- Spectrum acquisition
- Thickness tracking
- Data logging
- API for integration of the customer client software



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System Advantages

Key benefits

- ✔ Real-time endpoint detection
- ✔ Accurate oxide thickness monitoring
- ✔ Robust under slurry conditions
- ✔ Simple integration into CMP tools

Hardware advantages:

- Compact spectrometer
- Long-lifetime light source
- Fiber optic architecture

Software advantages:

- Flexible **DLL API integration to Modbus TCP interface**

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Broadband spectroscopic reflectometry advantage

Feature	Laser endpoint	Broadband reflectometry
Clear detection	Good	Good
Thickness measurement	Limited	Excellent
Stack sensitivity	Low	High
Multi-layer capability	Low	High

This is particularly attractive for:

- ✔ **oxide thickness monitoring**
- ✔ **dielectric CMP**
- ✔ **R&D / advanced nodes**

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