**New Frequency Domain Fiber Optic Interferometry for Advanced Wafer, Micro- and Nanostructure Metrology**

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### Motivation and Prior Art
Typical Fabry Perot thickness tools are limited to very thin films.

### Thick Layer Measurements require High Resolution Systems

![Diagram showing light interference patterns and thickness measurements.](image)

#### Inhomogeneous tapes heavily scatter light and complicate measurements.
Source of limitation: mechanical scanner affecting speed and accuracy.

#### Main Applications
- **Wafer Thickness**: backgrinding backetching process: Si or III/V wafers with or without tape, bumped wafers, bonded wafer and many other materials.
- **Bump height**
- **TSV depth**: in MEMS and 3DIC structures
- **Trench depth**

### FSN 413 Echoprobe Technology
EchoProbe Technology: Principle of Operation
Fiber optic Fourier Transform Spectrometer

#### Limitations
When reference and signal arms are equal we observe interference fringes.

Period of fine structure ~ 0.65 μm in air, or ~ 0.2 μm in Si

### Measurements on Single Layer Blanket Silicon Wafer

![Diagram showing wafer thickness measurements.](image)

#### Technology has no fundamental limit for Working Distance

- **Reflection from back surface**
- **Reflection from front surface**

### Elimination of scanner limitations utilizing Moiré Effect:
**Principle of FSM 8108 VITE**

Real Space Moiré Effect:
Two small spacing patterns having similar but slightly different spacing (and frequency) are overlapped.

When the two patterns are overlapped they produce a new pattern. The resulting pattern has a large spacing component (slowly varying component).

Slowly varying oscillations corresponding to the "beat" frequency resulting from product of transmission of two filters.

### FSM Effect - Frequency Space Moiré Effect
- Two thick etalons having slightly different thickness have fast oscillating transmission and reflection spectra with slightly different spacing of resonances as a function of wavelength.
- When the two such etalon filters are placed one after another the resulting transfer function has slowly varying components corresponding to the difference between optical thickness of each filter.
- **Frequency Space Moiré Effect - FSM Effect since it appears in wavelength (or frequency spectra) rather than in the real space.**
- The observation and measurement of this slowly varying component does not require high resolution spectrometer.

### Measurement on thick samples with small (low resolution) spectrometer

![Diagram showing measurement setup and data.](image)

#### FSM 8108 VITE Application and Performance
- Everything which interferometer technology FSM 413 can do BUT
- **Faster**: about 10x faster
- **More accurately**:
- **Repeatability**: >3x better repeatability

### Dynamic repeatability: Measurements on moving wafer
Scan time: 6.5 sec scan across 300mm Silicon wafer
This implies throughout
>50 wafers per hour (WPH) for typical recipe
Repeatability: +/- 0.072 um for typical 300 mm wafer

### CONCLUSIONS
- New FSM Effect based FSM 8108 VITE technology improvements
  - Speed x10
  - Accuracy and reproducibility x3
- New high speed applications possible
- No polarization sensitivity

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