Office of Technology Management

Characterization of Ultra Thin (< 50 Å) Dielectric Films to Increase Chip Production Efficiency and Decrease Waste (MEPR-FTIR)

Technology Reference

CU27

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Field

Quality control of semiconductor wafers

Key Words

Ultra-thin dielectrics

FTIR

Semiconductors

Production efficiency

Quality

Waste Reduction

Semiconductor manufacture

License Status

Seeking licensing partner

Patent Status

US 6,818,894 B2

Overview

Currently, FTIR is used to probe semiconductor wafers but cannot be used to probe the thinner dielectrics that will be used in the future.

Technical Summary

A novel technique has been developed and demonstrated for ex-situ or in-situ measurements of film thickness and other properties of ultra thin gate dielectrics. Mirror-Enhanced Polarized Reflectance Fourier Transform Infrared spectroscopy (MEPR-FTIR) has been used to effectively measure the properties of ultra thin silicon oxide films thermally grown on Si (100) and native oxides. This technique uses a standard FTIR instrument fitted with a mirror and a polarizer to overcome the problems resulting from the weak IR intensities normally encountered in ultra thin gate dielectrics such as SiO2.. MEPR-FTIR is applicable to new instruments or it can be retrofitted to existing FTIR instruments. MEPR-FTIR increases the intensity of the silicon oxide longitudinal optical (LO) mode by a factor of 20 thus allowing FTIR spectrometers with sensitivity down to 0.01% to probe sub-monolayers of silicon oxide on Si substrates.

Benefits

- Applicable to all processes that manufacture semiconductors.
- It is useful at the wafer scale
- Ability to operate with thinner dialectric layers (< 50 angstroms).
- With current technologies the signal strength decreases as the layer thickness decreases. This method overcomes this.

Areas of Application

- Semiconductor chip manufacture
- A real time system for nondestructive in-situ probing and characterization of ultra thin (< 50 Å) dielectric layers such as SiO2, Si3N4, SiNxOy and even Ta2O5 will increase semiconductor production efficiency and decrease waste.
- Future integrated circuit (IC) technologies will use thinner gate dielectrics.

Publications

- http://www.uic.edu/~takoudis
- http://www.uic.edu/labs/AMReL/

Stage of Development

- Demonstrated at full scale
- Silicon oxide films as thin as a few Å have been probed and the resulting relationship between film thickness and IR intensity of the silicon oxide longitudinal optical (LO) mode at 1252 cm-1 have been correlated with independent measurements as well as with theoretical predictions.