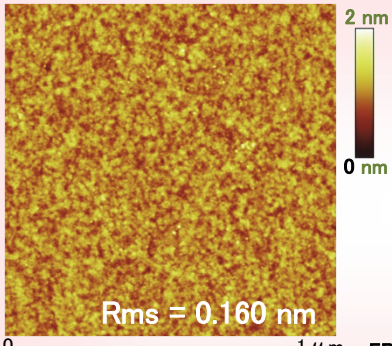
Evaluation of the interfacial structure of a SiO_2 thin film on a Si substrate

The physical and chemical structure at the interface of SiO_2 thin films is known to be closely related to the electrical properties of semiconductor devices. We can provide various analytical techniques (AFM, EPR, FT-IR, TEM-EELS, etc.) for the evaluation at the interface between SiO_2 and Si substrate.

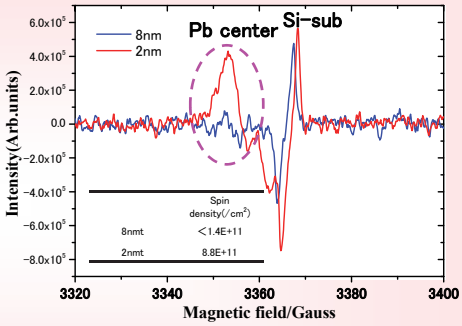
Table of analysis techniques for the oxide film

Composition	RBS, XPS
Chemical bonding	FT-IR, RAMAN, XPS
Sub oxide	XPS
Density	XRR
Roughness	AFM
Si-H, Si-OH	FT-IR, TDS
Thickness	TEM, ellipsometry, XRR
Interfacial layer	TEM-EELS, IR, XPS, PL
Optical constant	ellipsometry
Etching rate	ellipsometry
Defect	ESR, PL, CL
Impurity	SIMS

Evaluation of roughness and defects at the SiO_2/Si interface



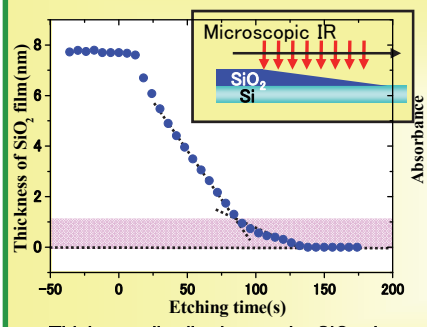
AFM image (after HF etching)



EPR analysis to detect defects at the SiO_2/Si interface

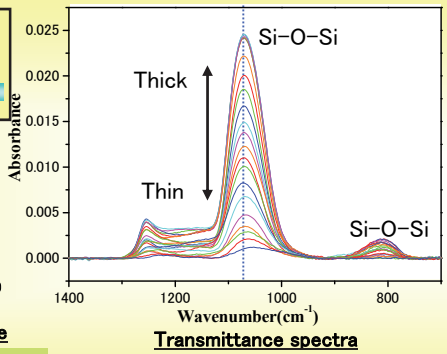
Roughness and defects at the SiO_2/Si interface influence its electrical properties.

Structure evaluation of the SiO_2/Si interface by using microscopic FT-IR



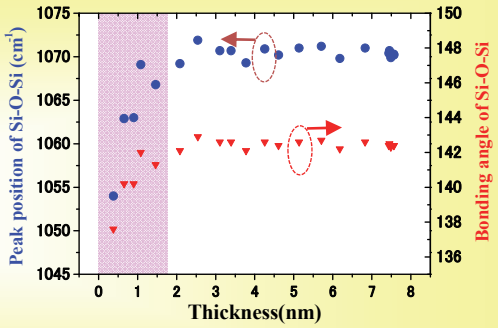
Thickness distribution on the SiO_2 slope

The SiO_2 slope was obtained using gradient etching pre-treatment. The etching rate changed at the SiO_2/Si interface



Transmittance spectra

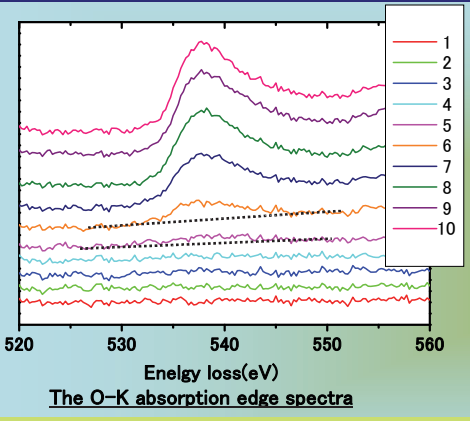
The Si–O band shifted to a lower wavenumber at the SiO_2/Si interface.



The Si–O–Si bonding angle at the SiO_2/Si interface

The Si-O-Si bonding angle became 4-degree smaller at the SiO_2/Si interface

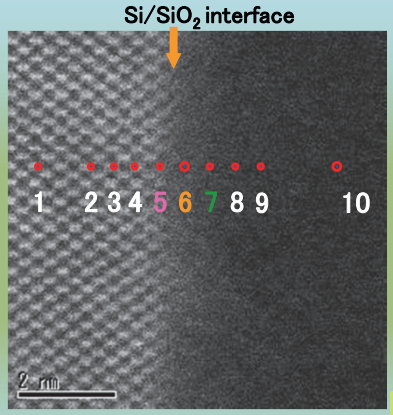
Evaluation of the SiO_2/Si interface by using TEM-EELS



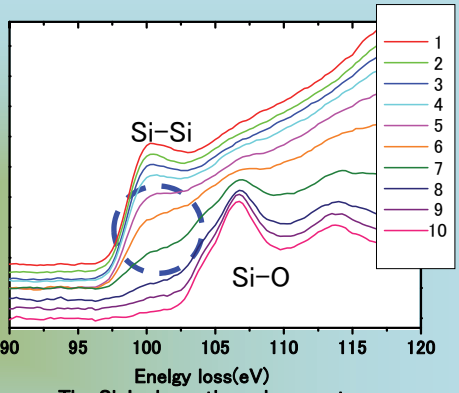
The O-K absorption edge spectra

- Oxygen has been detected at point 5.
- The peaks began to broaden at the SiO_2/Si (point: 5,6)

→ a suboxide component may exist.



S-TEM image



The Si-L absorption edge spectra

Si-Si bonds existed in the region about 1 nm from the Si surface.

→ the existence of Si-Si bonds might lead to the creation of suboxides and strain the Si-O-Si bond.

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