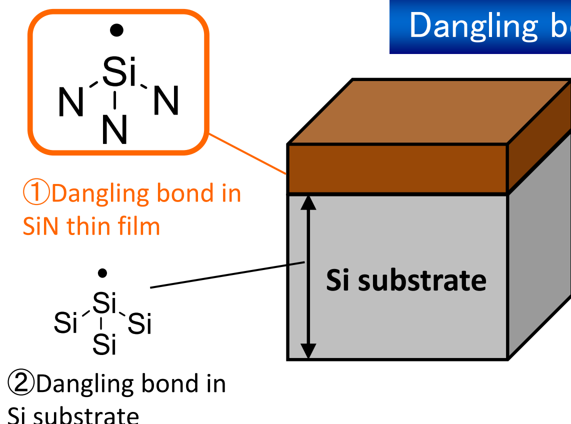
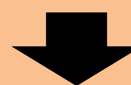
Evaluation of defect quantity of SiN ultrathin film (<10 nm) by ESR spectroscopy

Dangling bonds (i.e. defects) in SiN films can be quantified by ESR spectroscopy, but it is difficult to evaluate ultrathin films because strong signal of Si substrate overlaps with weak signal of the film. In this time, we have established a new method to remove substrate signal, making possible to evaluate ultrathin SiN films.

Dangling bond (i.e. defect) in SiN thin film



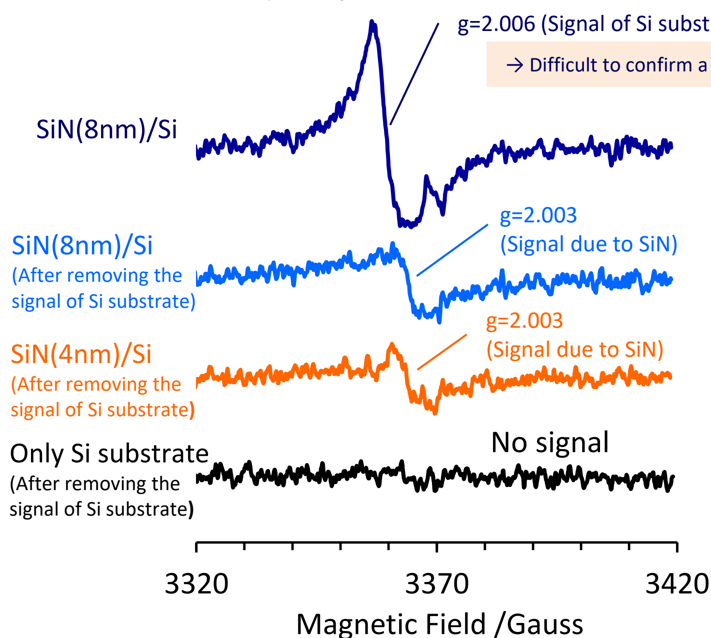
In the case of SiN ultrathin film (<10 nm), it is often difficult to confirm film signal because strong signal of Si substrate (②) overlaps with weak signal of film (①).



We have established a new method to remove substrate signal, making possible to evaluate ultrathin SiN films.

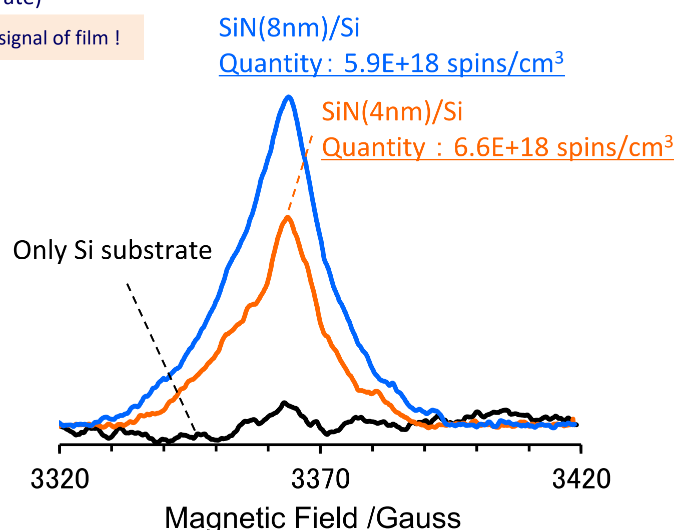
ESR spectra of ultrathin SiN films (Samples prepared by ALD*)

* ALD; Atomic Layer Deposition



After the signal removal treatment, there is no signal on "Only Si substrate", but the signals of SiN can be clearly confirmed on the ultrathin films.

ESR spectra in the integral form (Integral form on the left spectra)



The quantity of dangling bond (volume density) of SiN (8nm)/Si is comparable with that of SiN (4nm)/Si (within ± 10% of quantitative error).
⇒ It means that signals of the SiN films can be detected.

It is possible to evaluate quantities of defects in ultrathin SiN and SiON films, which are used in advanced semiconductor devices.

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