Lattice Strain at HfO/SiO\(_2\)/Si Interface

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**Introduction**

It is known that HfO\(_2\) is one of materials satisfying the conditions required of insulator layers for next generation semiconductor devices. However, lattice strain can be generated at HfO\(_2\)/SiO\(_2\)/Si interface when the HfO\(_2\) film is grown. We have some problems by this strain. For example, the degradation of electron mobility is typical things.

Recently, the extremely asymmetric X-ray diffraction method was established as a new method for studying interface [1]. In this case, by using this method, we measured the X-ray rocking curve of the lattice strain at HfO\(_2\)/SiO\(_2\)/Si interface with respect to the bulk. It has been reported that the integrated intensity of the rocking curve depends on a wavelength. Furthermore, this is sensitive to the strain [2].

In this research, we studied a lattice strain at HfO\(_2\)/SiO\(_2\)(2nm) /Si (100) interface by various film thicknesses (1~4nm) and with or without post-deposition annealing (PDA).

**Experimental**

Measurement of the strain on HfO\(_2\)/SiO\(_2\)/Si interface was done by measuring the X-ray rocking curve of the Si 311 reflection of the Si substrate under grazing incidence conditions at room temperature and atmospheric pressure by changing the X-ray wavelength in the range 1.395~1.4Å at beam line 15C, photon Factory.

**Results & Discussion**

Fig. 1 shows the integrated logarithmic intensities dependence on the X-ray wavelength for each sample. Here, the numbers in this figure are values of each slope. From this, we can see the tendency samples with PDA is higher slope value than samples without PDA for every film thickness. Therefore, the more tensile strain is generated by PDA.

**References**


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![Graph showing integrated intensities dependence on X-ray wavelength for each sample.](image-url)