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Lattice Strain at $HfO_2/SiO_2/Si$ 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 thick nesses (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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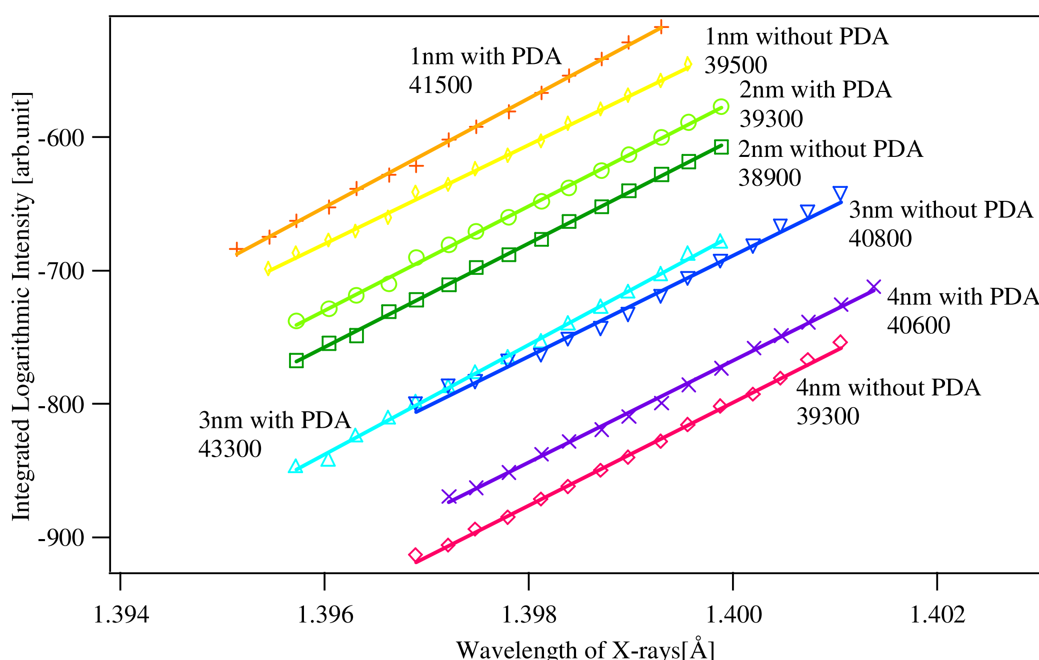

Fig. 1. The integrated intensities dependence on the X-ray wavelength for each sample.