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Characterization of a-Si/Fe/Si(111) interface by X-ray standing wave

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Introduction

Iron films deposited on Si(111)7x7 surfaces form various structures according as the deposition thickness changes. Those structures are interesting subjects of X-ray study because their atomic arrangements are not determined. We applied X-ray standing wave (XSW) method to investigation of an a-Si/Fe/Si(111) sample. This method has two merits: firstly, it can investigate buried interface structures non-destructively and secondly, its spatial resolution is very fine since it makes use of the interference fringes of x-rays as a scale

Experimental

Our sample was prepared in the following way. First, about 1ML of Fe was deposited onto a Si(111) substrate by an effusion cell at room temperature and the substrate was annealed at 500°C. After the annealing, the 2x2 RHEED pattern was observed as shown in Fig.1. Finally an a-Si cap layer of 90 Å was deposited to keep the 2x2 structure intact.

The X-ray measurement was performed using synchrotron radiation from a vertical wiggler of BL-14B. The geometry of the measurement is the (+,-) parallel setting of 111 reflection. X-rays of wavelength 1.2 Å were selected by a double-crystal monochromator. The X-rays were reflected by a Si(111) fore crystal and the Si(111) substrate subsequently in the experimental hutch. The intensity curve of the X-rays reflected from the sample (rocking curve) and the yield curve of fluorescent X-rays of FeKα were measured by a PIN detector and an SSD, respectively, around the 111 Bragg point

Results and discussion

The rocking curve and the yield of FeK fluorescence are shown in Fig.2. The profile of the measured rocking curve is slightly narrower than the theoretical curve probably because of the non-linearity of the PIN detector. The fluorescence yield curve, which indicates the interaction between the XSW field and Fe atoms, shows an almost symmetrical form. This means that Fe atoms diffuse at the interface and do not stay on any particular sites. Improvement of sample preparation is necessary for further study.

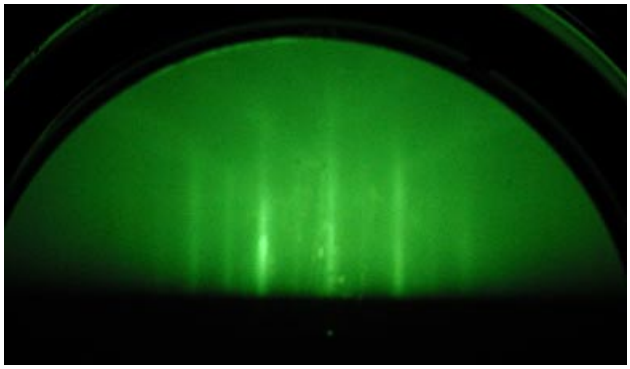

Fig.1. RHEED pattern observed along the silicon [112] azimuth.

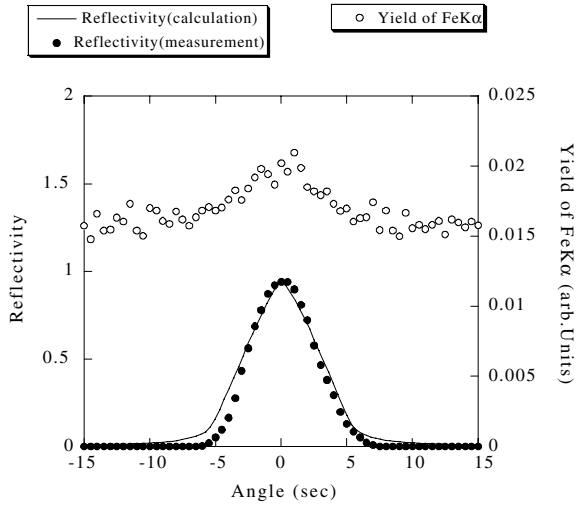

Fig.2. Rocking curve of the 111 reflection and yield of FeK fluorescence

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