§5. Measurement of X-Ray Spectrum by Using Pulse Height Analyzer

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In Large Helical Device (LHD), a pulse height analyzer (PHA) has been developed for observing the time evolution of x-ray spectrum.

The PHA is installed on the #2-O port (horizontal port), and basically equipped with a detector, an evacuating system, and a filter-exchanging system.[1] The systems are fully controlled by a computer.

The detector comprises a portable liquid nitrogen cryostat, four pre-amplifiers, and four Si(Li) elements mounted inside a vacuum enclosure with a Be window (12.5 μm thickness). The sight lines of the Si(Li) elements are collimated and adjusted to a central chord. A data-acquisition-system for high counting rate has been used. In actual experiments, the shaping time has been selected to 0.5 μs. A flux of 100 kcps has been normally achieved with energy resolution better than 300 eV at the Fe K_α line.

The PHA and the systems have been fully operated, and x-ray spectra have been successfully observed. Figure 1 shows a typical spectrum averaged over the four elements. The accumulation time of the spectrum has been 25 msec. In the spectrum the intensity shows a remarkable reduction below 3000 eV. This is due to the external filter being 140-μm-thick Be. The lines observed in the spectrum are the K_α lines emitted from metallic impurities. The time evolution of electron temperature is estimated with a time resolution of 15 msec as is shown in Fig. 2. In the estimation the range of impurity lines are not taken into account. Figure 3 shows the time evolution of the K_α lines emitted from Ti, Cr, and Fe, respectively.

From the estimations, it might be concluded that the time resolution better than 20 msec has been achieved.

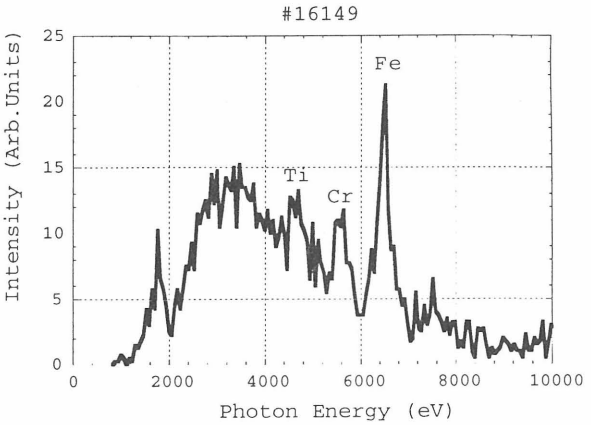

Fig. 1. Typical spectrum measured with the pulse-height-analyzer. The lines observed in the spectrum are corresponding to K_α lines emitted from Ti, Cr, and Fe,respectively.

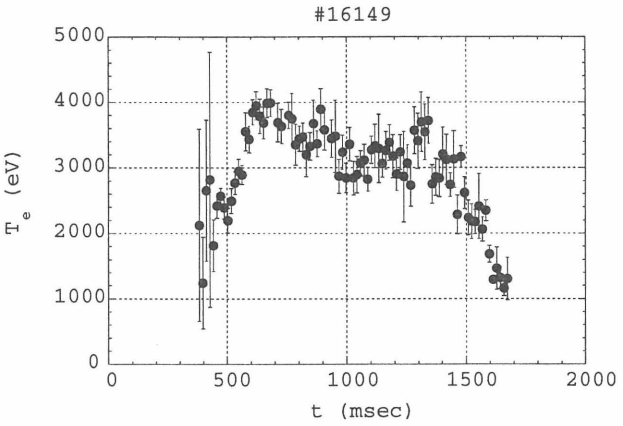

Fig. 2. Time evolution of electron temperature estimated from an experimental result.

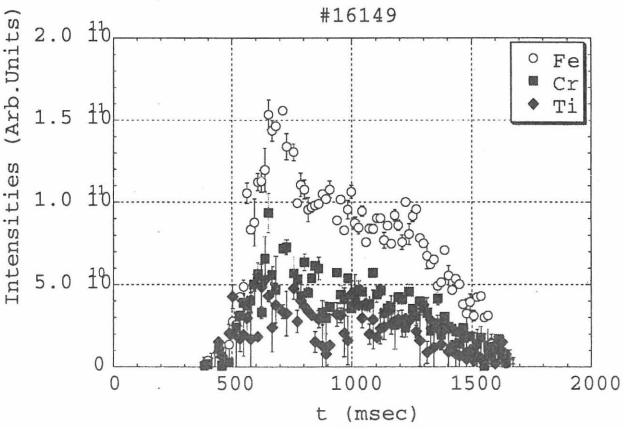

Fig. 3. Time evolution of line Intensity obtained from the experimental result.

Reference
1) Muto,S., *et al.*, (7th Int. Toki Conf., 1995), Fus.Eng.Des. **34-35** (1997) 205-207.