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Observation of device cross-sectional thin films prepared by FIB using JEM-2500SE, an electron microscope for nano-analysis

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Recently, the structure of electronic devices becomes so fine that the observation of nm order resolution is requested. Therefore, transmission electron microscope (TEM) observation of thin films of cross-sectional devices prepared by Focused Ion Beam (FIB) becomes more and more important. However, so far, although a great variety of information has actually been obtained by TEM operation, an experienced operator and an exclusively setting up room were required. These facts have made a quick analysis and feedback difficult. We report here observation of device cross-sectional thin films prepared by FIB using JEM-2500SE, an electron microscope for nano-analysis developed newly in order to solve these problems.

Scanning secondary electron image, scanning transmission electron bright field image, scanning transmission electron dark field image, transmission electron image, and electron diffraction pattern can be observed by JEM-2500SE. All of the operation is PC controlled. This electron microscope can be set up in a bright room. The procedure for analyzing thin films of cross-sectional devices prepared by FIB is as follows.

1) Parts prepared by FIB are searched with secondary electron image.
2) The specimen is so tilted that crystal orientation of specimen coincides with zone axis of low indices with diffraction mode (FIG.1).
3) First, astigmatism is corrected with ronchigram mode (FIG.2), and then a high contrast and high-resolution image is observed with STEM mode (FIG.3(a)). Next, Energy Dispersive X-ray Spectroscopy (EDS) point analysis, EDS line analysis, and EDS elemental mapping are carried out in order to identify the composite elements in the specimen. Solid angle for EDS is 0.3sr.
4) When a higher-resolution image is necessary, TEM mode is used(FIG.3(b)).

These operations are easily changed through GUI of PC. Moreover, from high-angle annular dark field (HAADF) image (FIG.4) a composition contrast can be obtained. If the HAADF image is used with EDS analysis, the composition analysis can be carried out more effectively.

The electron microscope should have the above functions in order to obtain the above-mentioned information. Since the multi-function of this newly developed JEM-2500SE can be easily operated on all of the mode, this electron microscope is the most suitable analytical tool to observe device cross-sectional thin films.

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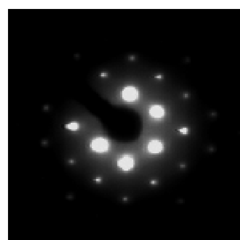

FIG.1 Diffraction pattern of Si (110) substrate of a device cross-sectional thin film.

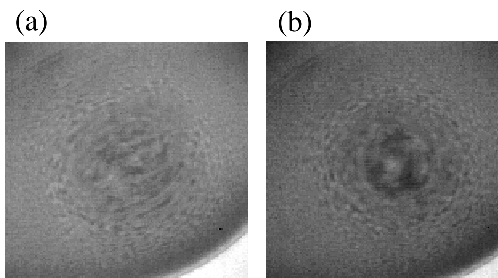

FIG.2 The image with astigmatism (a) and the image without astigmatism (b) by ronchigram mode.

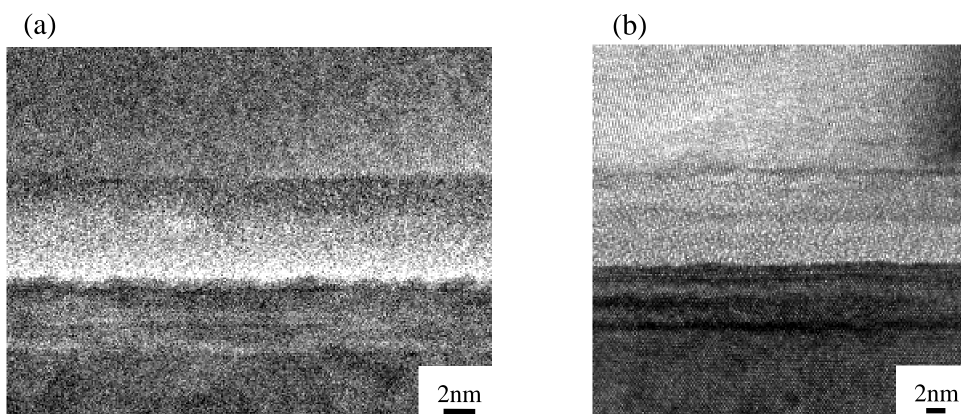

FIG.3 HRSTEM image (a) and HRTEM image (b) of a device cross-sectional thin film.

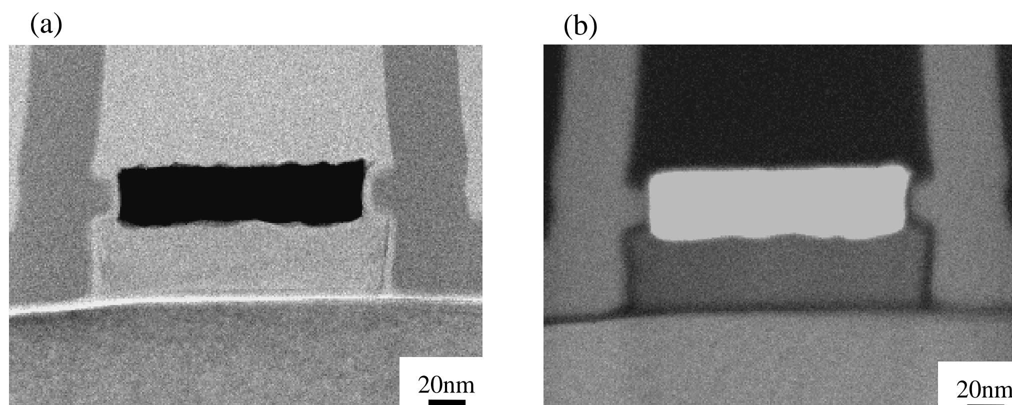

FIG.4 STEM-BF image (a) and STEM-HAADF image (b) of a device cross-sectional thin film.

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