

## A New High-Resolution Electron Microscope with Easy Operation System for Nano Analysis

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In recent years, circuit integration and density of semiconductor devices are rapidly increased by the advance of manufacturing technology. SEM is in a common wide use for the evaluation of semiconductor processes in the product fabrication. However, the observation by using SEM has become gradually difficult because of smaller design rules. Accordingly, a new high-resolution electron microscope having the functions of TEM, STEM and SE (Secondary Electron) image is required. It is possible to easily observe for the high-resolution image by using TEM function in comparison with using STEM function. Moreover, the operation should be easy, and the result of observation and analysis should be as rapid and accurate as possible. The JEM-2500SE Nano analysis electron microscope has been developed in order to satisfy such requirements. Figure 1 shows an outer view of the JEM-2500SE. It is an electron microscope of accelerating voltage 200kV with Schottky type field emission electron gun. Specifications of JEM-2500SE are shown in Table 1. The advantages of this new microscope are described in the following.

1. Easy operation: BF (Bright Field) STEM image, DF (Dark Field) STEM image, SE image, TEM image and diffraction pattern are observed by one touch switch operation on a Windows<sup>®</sup> based personal computer controlled LCD (liquid crystal display) monitor in a bright room. An example screen of GUI (Graphical User Interface) shows in Fig. 2. All the images and the pattern can be observed easily by using the simplified operation panel (Fig. 3). Besides, the images and pattern are recorded in a digital image format, so that direct measurement of length, image processing and image transfer to other computers are possible. No dark room is required because of photo film-less operation.

2. High resolution observation: Although the high sensitivity analysis is possible, high-resolution images can be observed: 0.14nm for TEM lattice image, 0.2nm for STEM lattice image, and 1.0nm for SE point image resolution have been achieved. Figure 4 shows a TEM image of a gold single crystal, proving 0.14nm of line image resolution.

3. High sensitivity elemental analysis function: EDS (Energy Dispersive X-ray Spectroscopy) detector with 0.3sr of solid angle and 25° of take-off angle is prepared as the option equipment. It enables a highly sensitive analysis in a short time compared with previous conventional electron microscopes. In addition, PEELS (Parallel Electron Energy Loss Spectroscopy) or Imaging PEELS is also prepared as the option equipment.

4. Room environment: The JEM-2500SE has 2.1m of column height. Accordingly, it is can be installed in a usual room. A new anti-vibration system equipped with air suspension system is adopted, and the effect of the installation room environment is minimized.

The JEM-2500SE is a new electron microscope making the structure observation and the elemental analysis easily in a short time for nano analysis.

TABLE 1. Specifications.

Acc. Voltage	200kV
Electron gun	ZrO/W(100) Schottky
Resolution	TEM: 0.14nm (lattice) 0.1nm(attainable) STEM: 0.2nm (lattice) SEI: 1.0nm (point)
Image	STEM (BF, DF) TEM Diffraction SEI
Tilting angle	$\pm 30^\circ$
Spec. movement	$\pm 1\text{mm}(X,Y), \pm 0.5\text{mm}(Z)$
Spec. holder	FIB tip-on holder
TEM Mag.	x4000 ~ x20M
STEM Mag.	x100 ~ x10M
Camera Length (on 18.1in LCD)	600 ~ 5000mm
EDS* solid angle	0.3sr
take-off angle	$25^\circ$

\* option equipment



FIG. 1. Outer view.

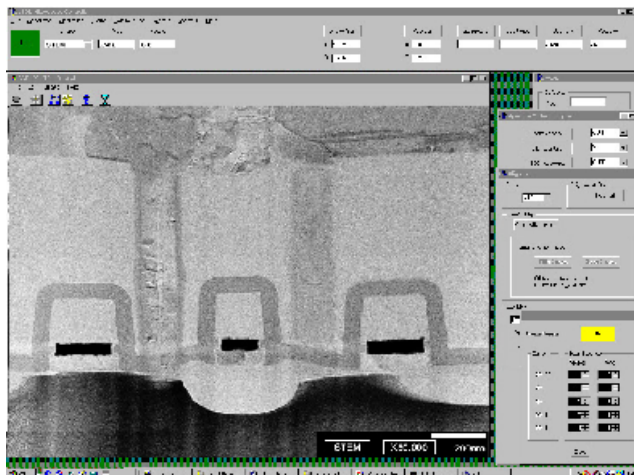


FIG. 2. An example of GUI screen.



FIG. 3. Operation panel.

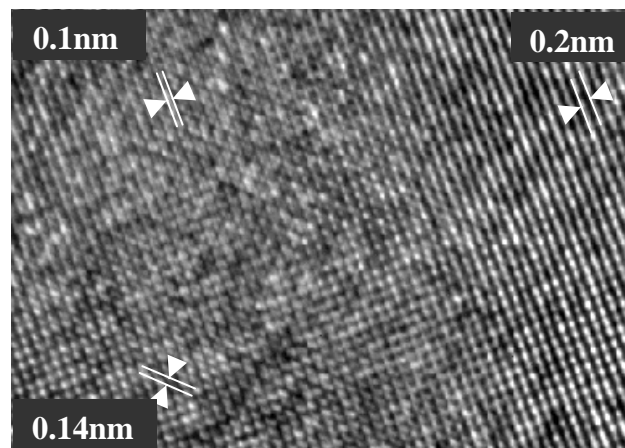


FIG. 4. HREM image of gold single crystal is obtained by using JEM-2500SE.