

## Auger Microprobe JAMP-9500F

### 1. General

An Auger microprobe is a surface analysis system designed to determine elemental compositions and chemical state in areas a few nm deep from the sample surface by measuring the energy levels of Auger electrons excited by the electron beam from a sample. The Auger microprobe features high analytical spatial resolution because its analysis area is determined by the size of the focused probe. Most of the recent Auger systems employ a Schottky field emission gun (FEG) for micro area analysis.

The JAMP-9500F is a field emission Auger microprobe featuring a Schottky FEG and a unique electron optic system to achieve high spatial resolution. The system uses a hemispherical energy analyzer, multi channel detector, and incident lens optimized for Auger analysis, acquiring high sensitivity, high energy resolution Auger spectra. It also supports analysis of insulators, a difficult application in the conventional Auger systems, utilizing its neutralizing ion gun to compensate charges.

### 2. System composition

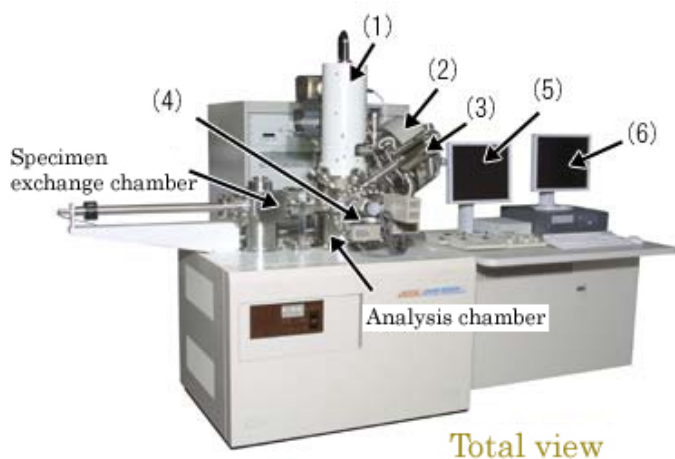


Figure 1 is an external view of the JAMP-9500F.

The system comprises the following units: (1) electron optic system (EOS); (2) energy analyzer; (3) ion etching gun; (4) specimen stage; (5) EOS controller/display; and (6) Auger analyzer controller/display.

The base unit is composed of two chambers, specimen exchange chamber and analysis chamber, which are isolated with a gate valve. The analysis chamber is evacuated with a sputter ion pump (SIP) to maintain high vacuum of  $5 \times 10^{-8}$  Pa or better. The specimen exchange chamber is evacuated with a turbo molecular pump (TMP) and rotary pump (RP).

### 3. Electron optic system (EOS)

The electron optic system for Auger analysis needs to achieve high current with the smallest possible probe size.

The JAMP-9500F, using its innovative in-lens FE gun assembly incorporating the ZrO/W Schottky FE emitter and condenser lens, efficiently collects electrons generated from the emitter, achieving a probe

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current of 200 nA or higher.

The minimum probe size for Auger analysis has been improved to 8 nm.

Figure 2 shows a secondary electron image of gold particles on graphite at 25 kV and 1 nA. The figure also shows the probe size acquired from a line profile of the same sample.

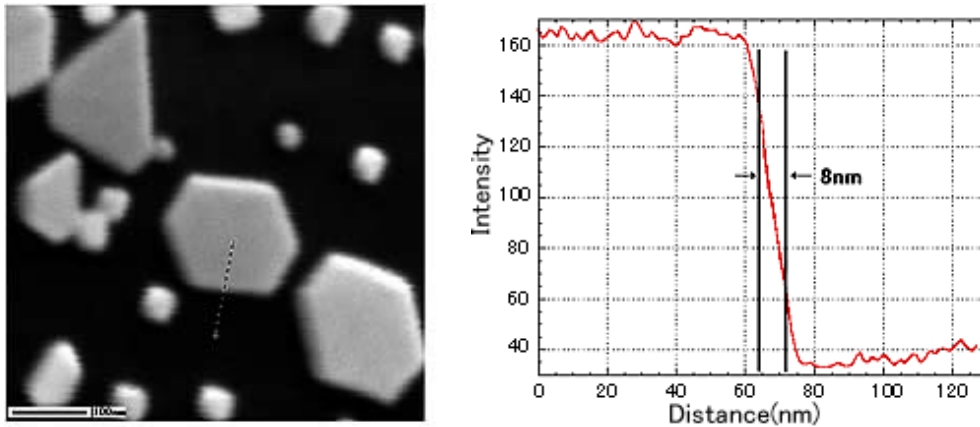


Figure 2 Secondary electron image (25 kV, 1 nA) and line profile  
Sample: Gold particles on graphite

## 4. Energy analyzer

The hemispherical analyzer (HSA), designed to acquire spectral data at high energy resolution, enables analysis of chemical bonding from the chemical shift and energy loss spectra.

Figure 3 shows the elastic scattering peak at 2 keV and Auger spectra of copper (Cu) acquired in High Energy and High Sensitivity modes.

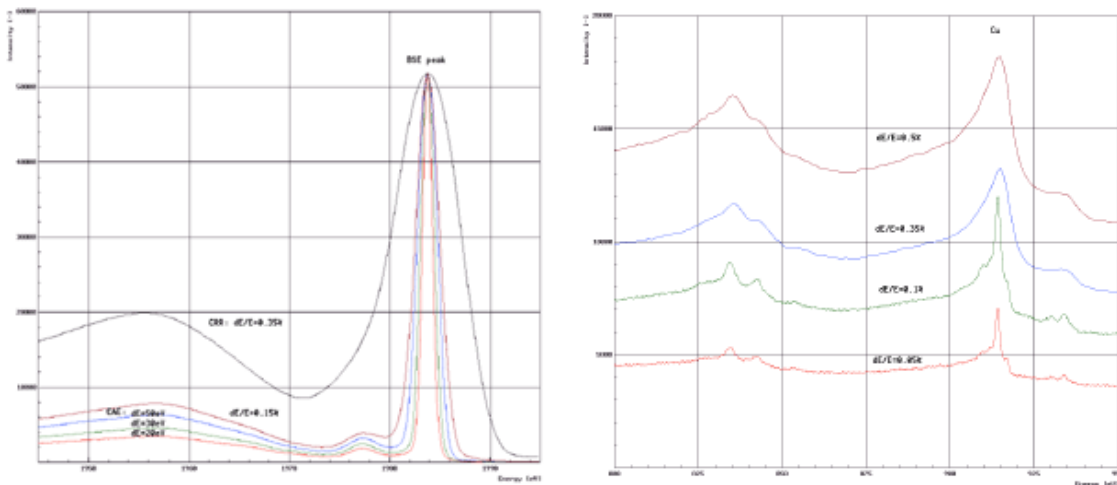


Figure 3 Elastic scattering peak and Cu-LMM Auger spectra

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## 5. Ion etching gun

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The ion etching gun, normally used for sample surface cleaning and depth profiling, can neutralize charge accumulated on insulators by projecting ions at 20 to 30 eV.

For this application, the ion etching gun needs to achieve high ion current density in the low energy range. The JAMP-9500F employs a floating micro ion etching gun (FMIED) designed to accelerate ions at voltages higher than the accelerating voltage to increase the ion current density.

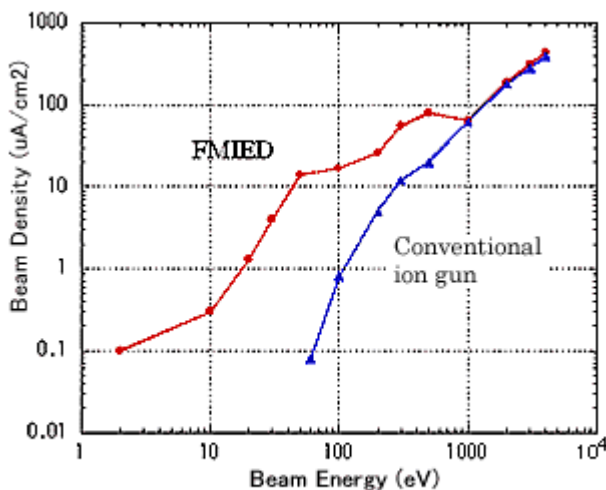


Figure 4. Ion energy vs. ion current density

Figure 4 compares the ion current density at different ion energy levels between the FMEID and conventional ion gun.

The FMEID can neutralize charge without sputtering the sample by projecting ions at 20 eV or less.

## 6. Specimen stage

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The JAMP-9500 features a large specimen stage for a full coverage of disk samples 95 mm in diameter in imaging and analysis. The stage is a 5 axis motor drive eucentric goniometer stage to assure the stable area of view when the sample is tilted. Its rotation center correction enables ion etching at any position while rotating the sample.

## 7. Expandability

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The JAMP-9500F can be used as an ultra high vacuum scanning electron microscope (UHV-SEM), since its EOS is controlled independently from the Auger analyzer system.

With ports to accommodate devices including electron backscattered diffraction system, backscattered electron detector, and energy dispersive X-ray analyzer (EDS), the JAMP-9500F supports various applications under ultra high vacuum.

## 8. Software

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The Auger analysis software, while compatible with the conventional JAMP-7800 series, has a new powerful feature designed to collect Auger images from areas of any size and at any location. This enables speedy acquisition of high resolution Auger images from a target area.

Figure 7 shows an Auger image acquired from a defined area.

The Swing Mouse can travel between the viewing image and the Auger image.

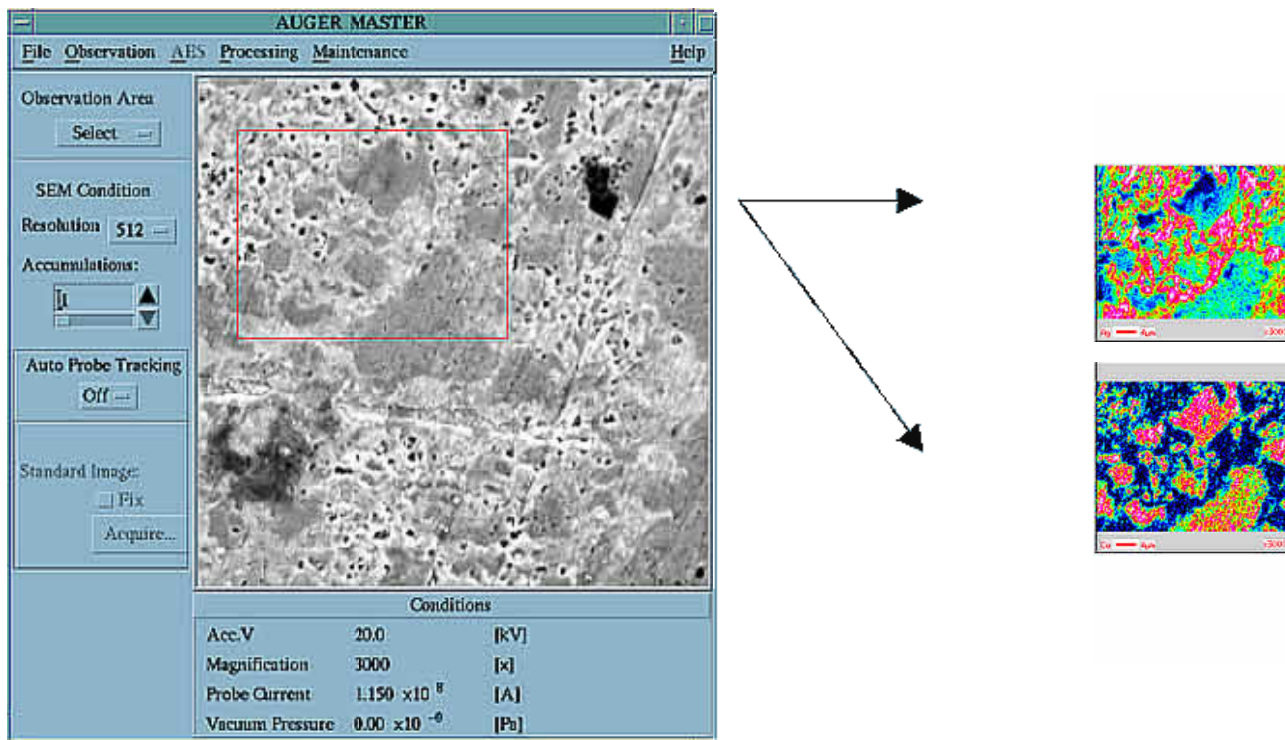


Figure 5 Auger image acquired from defined area (top: Ag bottom: Cu)

## 9. Summary

We have introduced new hardware and software features of the JAMP-9500F. The 9500F has a secondary electron image resolution of 3 nm and a minimum probe size of 8 nm for Auger analysis, collectively improving spatial resolution. Its energy analyzer has a sensitivity level 1.5 times higher than the conventional system, enabling ultra micro area analysis.

With its neutralizing gun for insulator analysis, the JAMP-9500F is a powerful surface analysis tool for a wide range of applications.