技術情報 Technical Information

Combining UHV-SEM and EBSD

Electron Backscatter Diffraction Pattern, abbreviated to EBSD or EBSP, is increasingly used with scanning electron microscopy (SEM) as a technique to analyze crystal orientations in localized area. EBSD, combined with ultra high vacuum scanning microscopy (UHV-SEM), enables efficient observation of crystal orientations.
Depth of EBSD analysis is approximately 50 nm. The table below compares the depth of analysis among different analytical techniques.

	Surface analysis (AES, XPS)	EBSD	EPMA, EDS
Depth (nm)	5	50	1000
Effect of contamination	High	Moderate	Low
Vacuum in specimen chamber	Ultra high vacuum needed 10^{-8} Pa or better	High vacuum desirable 10^{-7} Pa or better	Normal vacuum 10^{-6} to 10^{-5}Pa

EBSD is a technique close to surface analysis in terms of the depth of analysis. As a result, contamination buildup on the sample surface will compromise the diffraction pattern, failing to clarify the boundary of crystal particles in EBSD imaging.

Contamination is more pronounced at higher magnification as the current density of the projected probe increases. Effect of contamination is significant among chemically active materials such as magnesium alloy, rare earth metal, and poly silicone film.

Advantages of UHV-SEM/EBSD combination

1. EBSD analysis at higher magnification
2. EBSD analysis of chemically active materials
3. Simultaneous Auger analysis of impurities or precipitates at grain boundary

- Ultra high vacuum in the order of 10^{-8} Pa in specimen chamber (no contamination from specimen chamber atmosphere)
- Accompanying ion gun eliminates inherent surface contamination.

The base unit of the JAMP-9500F or JAMP-7800 series is a UHV-SEM where specimen and gun chambers are kept in ultra high vacuum in the order of 10^{-8} Pa. The accompanying ion etching device eliminates the contaminants initially present on the sample surface.

With EBSD added, the JAMP system is expected to support high magnification EBSD imaging of any sample free from the effect of contamination.

Further analysis with Auger spectroscopy will enable studies of elemental distributions at the grain boundary, for more comprehensive and accurate analysis.

We have developed a specimen chamber for the JAMP-7800 incorporating EBSD. Figures 1 and 2 are its external view and cross section respectively.
As Figure 2 shows, the specimen chamber is characterized by the positions of the Auger spectrometer and EBSD detector with reference to the specimen stage. This arrangement allows the operator to perform Auger and EBSD analysis of the same area of view of a sample by simply changing the tilt angle of the specimen stage (30 degrees for Auger and 70 degrees for EBSD).

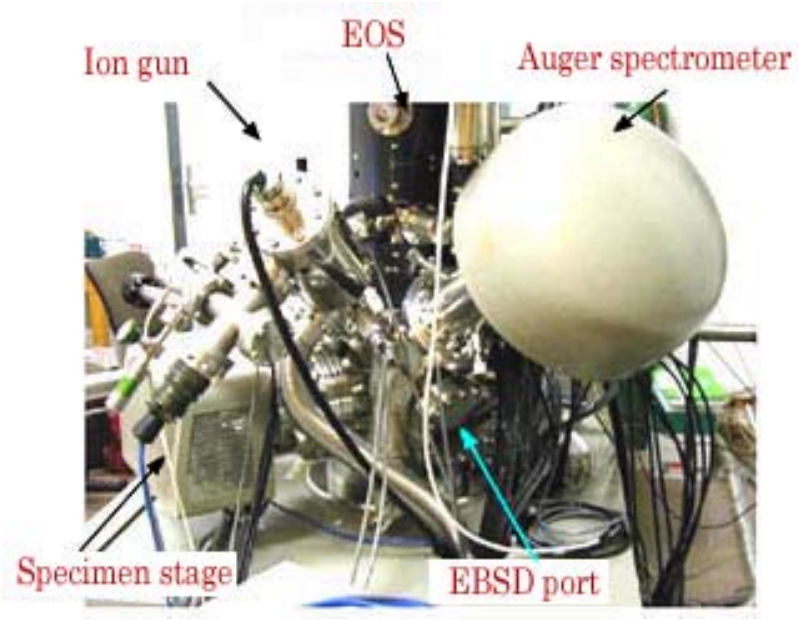

Figure 1 Specimen chamber with EBSD port – An external view

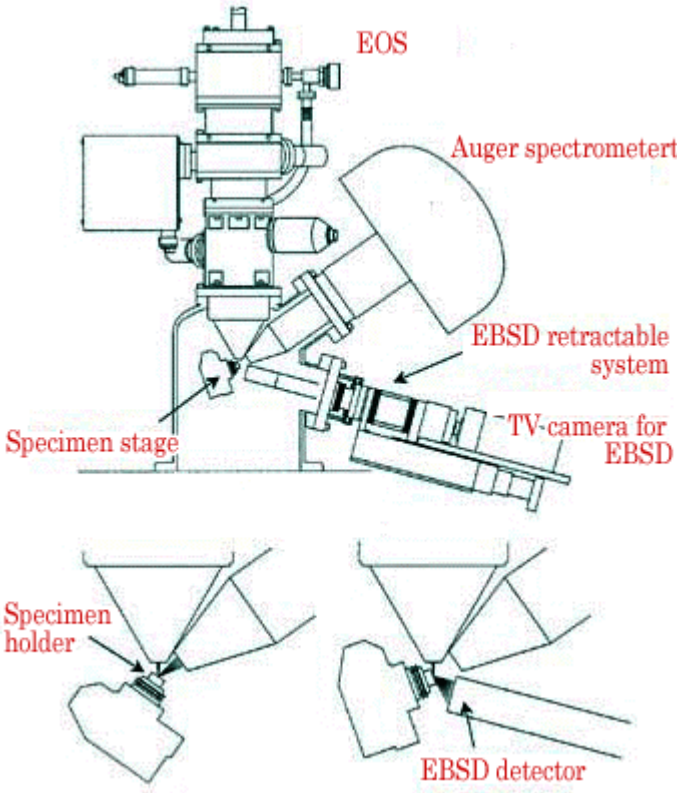

Figure 2 Specimen chamber with EBSD port – A cross sectional view