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XM-17560

AUTOMATIC PARTICLE ANALYSIS PROGRAM

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JEOL
Serving Advanced Technology

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XM-17560

AUTOMATIC PARTICLE ANALYSIS PROGRAM

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NOTATIONAL CONVENTIONS AND GLOSSARY

General notations

⚠ **WARNING :**	A potentially hazardous situation which, if not avoided, could result in death or serious injury.
⚠ **CAUTION :**	A potentially hazardous situation which, if not avoided, could result in minor injury or material damage. Material damage includes, but is not limited to, damage to related devices and facilities, and to acquired data.
– CAUTION – :	Points where great care and attention is required when operating the device to avoid damage to the device itself.
✍ :	Additional points to be remembered regarding the operation.
☞ :	A reference to another section, chapter or manual.
1, **2**, **3** :	Numbers indicate a series of operations that achieve a task.
◆ :	A diamond indicates a single operation that achieves a task.

CONTENTS

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1 GENERAL

This program is used for the JXA-8100/8200 series electron probe microanalyzers in order to perform fully automatic operations for particle analysis, such as (1) moving the sample stage to the analysis area, (2) collecting backscattered electrons, (3) analyzing particles, (4) analyzing elements of the particles found and (5) determining chemical types based upon the chemical composition. This program enables you to simultaneously obtain the quantity of particles and the elements of the particles.

2 SPECIFICATIONS

Measurement area: Areas of up to 100 × 100 (a maximum area of 10,000 can be specified)

Image signal to be captured: Backscattered or secondary electrons generated by electron beam scanning

Number of pixels of image signal:
Maximum 1,024 × 1,024 pixels, 16-bits wide

Size of pixel: Variable according to electron-beam scanning magnification

Point analysis: Qualitative analysis (WDS or EDS), Semi-quantitative analysis (WDS or EDS) and Quantitative analysis (WDS/EDS combined) can be specified.

Maximum number of analysis points per sample:
10,000 points per measurement area

Specifications for quantitative analysis

Number of measurement elements of an unknown sample:
Maximum 30 elements in total with WDS and EDS

WDS X-ray measurement time:
0.1 to 1,000 sec

EDS X-ray measurement time:
1 to 10,000 sec

Correction calculation: ZAF correction for metals, ZAF correction for oxidized substances and other optional corrections can be selected.

Specifications for semi-quantitative analysis with WDS or EDS

Number of measurement elements:
Maximum 30 elements

Measurement elements: A-class elements are measured with the default condition. Measurement elements can be specified or eliminated by the user.

Image display function: Level change
Enlargement and reduction
Selection of pseudo-color or gray scale
Text input
Reading in of the position and intensity at an arbitrary point in an image
Measurement of the distance between two arbitrary points in an image

Display of line analysis between two arbitrary widths in an image
Displaying the point-analysis position on an image
Point-analysis position coordinate transformation by mouse Average atomic-number image by calibration-curve factor

Particle analysis function

- Filter processing: Smoothing, median, sharpening, edge enhancement, shading correction, smoothing while retaining edges, arbitrary filter
- Binarization: Automatic binarization by discrimination, manual binarization by histogram (the analysis area or the threshold value to be specified), multiple coding up to 7 levels
- Labeling: 4-neighbor or 8-neighbor labeling
- Binarization filter processing: Removal of micro-particles, outline detection, filling of hole, particle separation, contraction, dilation, shrinking, thickening, thinning
- Particle removal: Mouse designation, label number designation, area value, others
- Particle measurement: Area, area %, stage position, perimeter, compactness, Heywood diameter, maximum angular distance and width, maximum length in x and y directions, Feret's diameter in x and y directions, Euler's number, moment, main axis and angle
- Display on particles: Label number, maximum angular distance, Feret's diameter, compactness, analysis coordinates
- Histogram display: Histogram display of measured values. Cumulative frequency is also possible.
- Point-analysis position saving: The stage position of the center of gravity of a particle. Number of point-analysis positions to be saved can be specified. Sorting by area or compactness is possible.
- Maximum number of labeling operations: 32,768 per image

3 MENU TREE STRUCTURE

File (Refer to Chapter 5.)
- Get image
- Show parameter
- Load image
- Save image
- Delete image
- Exit

Operation (Refer to Chapter 6.)

4 OPERATION

4.1 Outline of Operation

The process of automatic particle analysis can be divided into the following four steps: (1) capturing an image signal, (2) executing particle analysis, (3) analyzing found particles and (4) determining chemical types based upon chemical composition. It is necessary to set parameters suitable for the operation you are going to perform, but most parameters do not have to be input again once they are set. After you have finished the parameter setting, specify the measurement area and carry out the calibration of a backscattered electron image signal. Then, you can leave the particle measurement to the automatic particle analysis function.

This program consists of four menus: “File,” “Operation,” “Particle” and “Analysis.”

- Using the File menu, you can manually capture an image signal, save the captured image or load a map image that has already been captured. The image data obtained with this automatic particle analysis function is compatible with map analysis data. Therefore, off-line particle analysis can be performed on the map images that have been captured with the usual measurement operations.
- Using the Operation menu, you can operate on the displayed image in various ways. You can enlarge or reduce the image, display a histogram, perform a level change based upon the histogram, input text and carry out point analysis and line analysis.
- Using the Particle menu, you can perform particle analysis manually and set the parameters required for automatic particle analysis.
- Using the Analysis menu, you can determine the measurement area, specify the type of image to be captured, select the kind of point analysis and turn the realtime monitor on or off.

The following are the general procedures for setting the conditions required to carry out automatic particle analysis using an actual sample.

1. From the Analysis menu, select the group name and sample name whose measurement results are to be saved.
2. Capture an image signal on the actual sample manually. At that time, adjust the image brightness and contrast. Also, select the magnification and the number of pixels according to the size of the particles you want to find.
3. Select “Auto” from the Particle Analysis menu to display the “Auto” window for setting the parameters required for automatic particle analysis. Set the parameters in this window while carrying out particle analysis manually. After completing the parameter setting, try to run the analysis from the beginning and save the parameters in a file with a name attached.
4. When you have developed a feeling of the particle analysis parameters, select the image signal type and electron optical condition for automatic particle analysis from the Analysis menu.
5. Set the measurement area in the “Stage Condition” window selected from the Analysis menu.

6. When carrying out analysis, select the type of analysis and the analysis conditions that have already been set. In this Automatic Particle Analysis Program there is no routine for setting the analysis conditions for qualitative analysis, semi-quantitative analysis, quantitative analysis or other types of analysis. Therefore, set the elements to be analyzed and the other parameter items in advance, referring to the instruction manual for quantitative analysis, semi-quantitative analysis.
7. Since chemical-type setting conditions are initially unknown, select “Learn Mode On” from the “Option” menu in the “Chemical Type” window.
8. Select “Preset” from the Analysis menu and carry out analysis.
9. When observing the measurement on the realtime monitor, click on “Start Monitor” in the Analysis menu

Then, all the conditions for particle analysis have been established. So, record the conditions in a file and save it in the “Condition Save” window selected from the Analysis menu. For ordinary analysis, steps 1, 5 and 8 above are sufficient.

4.2 Starting and Terminating Program

4.2.1 Starting Program

Click on the Analysis icon in the EPMA menu, and the pull-down menu will appear. Click on “Online Particle Analysis” in the pull-down menu, and the “Particle Analysis” window will be opened, as shown in Fig. 4.1.

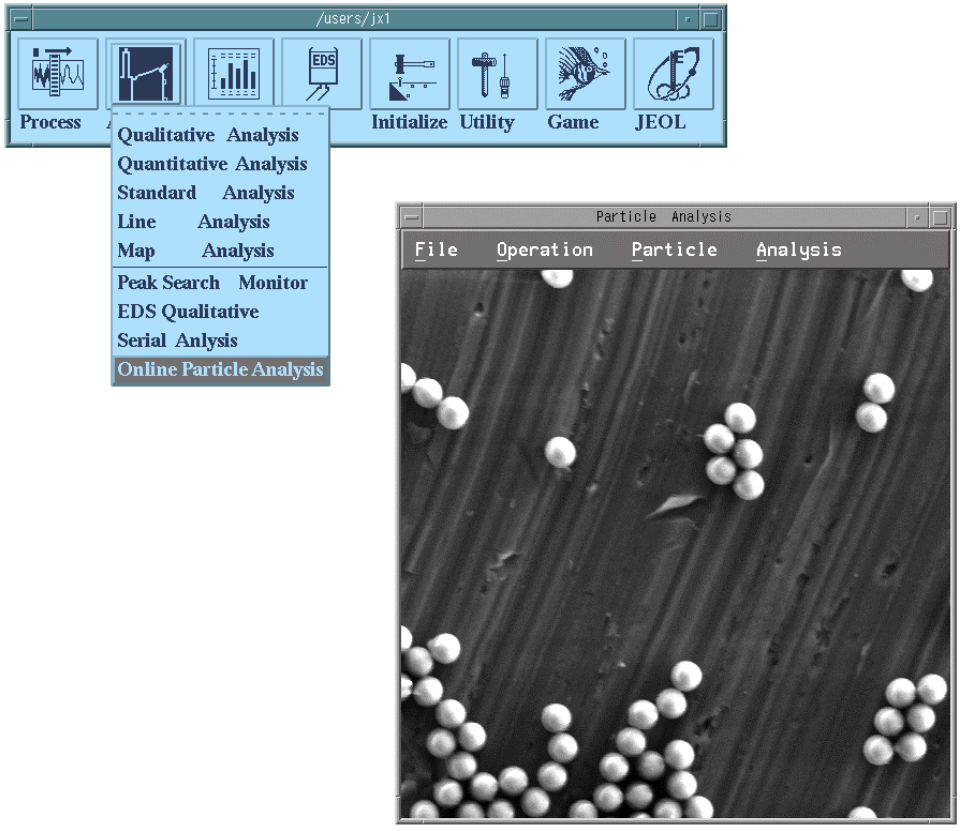


Fig. 4.1 “Particle Analysis” window

4.2.2 Terminating Program

Click on the “File” menu shown in Fig. 4.1, and the pull-down menu will be displayed as shown in Fig. 5.1. Click on “Exit” in the pull-down menu, and the function and image display window shown in Fig. 4.1 and any other relevant windows, if opened, will all be closed.

5 FILE MENU

Click on the “File” menu shown in Fig. 4.1, and the pull-down menu will be displayed as shown in Fig. 5.1.
The following processing functions can be executed.

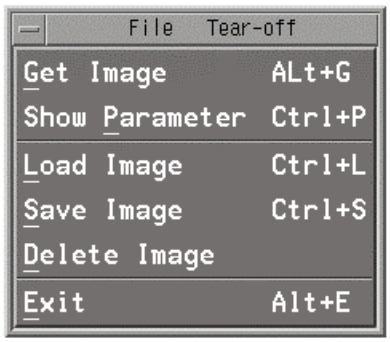


Fig. 5.1 “File” pull-down menu

5.1 Get Image

Select “Get Image” from the “File” menu shown in Fig. 5.1, and the “Get ISD” window will appear as shown in Fig. 5.2.
In this window you can select the kind of image signal, data points (number of pixels), magnification, brightness and contrast and the number of integrations.
For the kind of image signal, select SEI (secondary electron image), COMP (backscattered electron image), TOPO (topographic image) or AUX (auxiliary image). For the number of image data points, select 128, 256, 512 or 1024. When the image signal is SEI or BEI, adjust the image brightness and contrast by clicking on the “Cont./Bright.” button. For accumulation, select 1, 2, 4, 8, 16 or 32. When accumulation is 1, the maximum value of data is 2040.

Click on the “Get Image” button in the “Get Image “ window. Then, image collection will begin. If you want to stop the image collection while it is in progress, click on the “Get Image” button again.

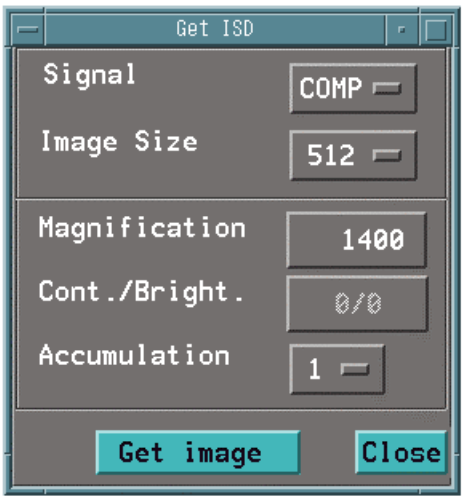


Fig. 5.2 “Get Image” window

5.2 Show Parameter

Select “Show Parameter” from the “File” menu shown in Fig. 5.1, and another window to display image-measurement conditions will be displayed. To close this window, click on the “Close” button. Select display items by clicking on “Parameter” in the “Operation” menu. When you want to indicate a color bar and a micron marker on the display window, select them by clicking on “Display Mode” in the “Operation” menu.

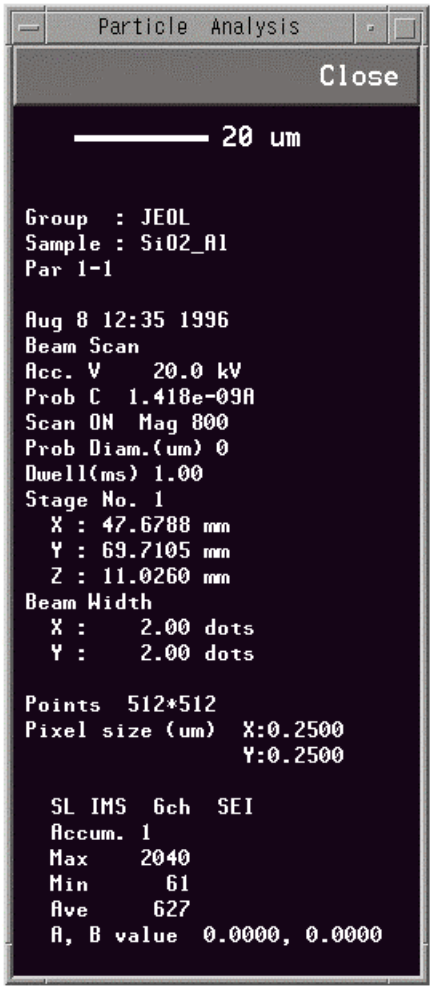


Fig. 5.3 Image measurement condition window

5.3 Load Image

Select “Load Image” from the “File” menu shown in Fig. 5.1, and the “Load Image” window will be opened as shown in Fig. 5.4. Select sample name, sample number and kind of signal in this window. When you want to change Group, click on the “Group” button.

When you click on the “OK” button in the “Load Image” window (as shown in Fig. 5.4, for example), your selection of sample name “Rutubo (crucible)” No. 1 is finalized and the image is displayed, and then the “Load Image” window will be closed.

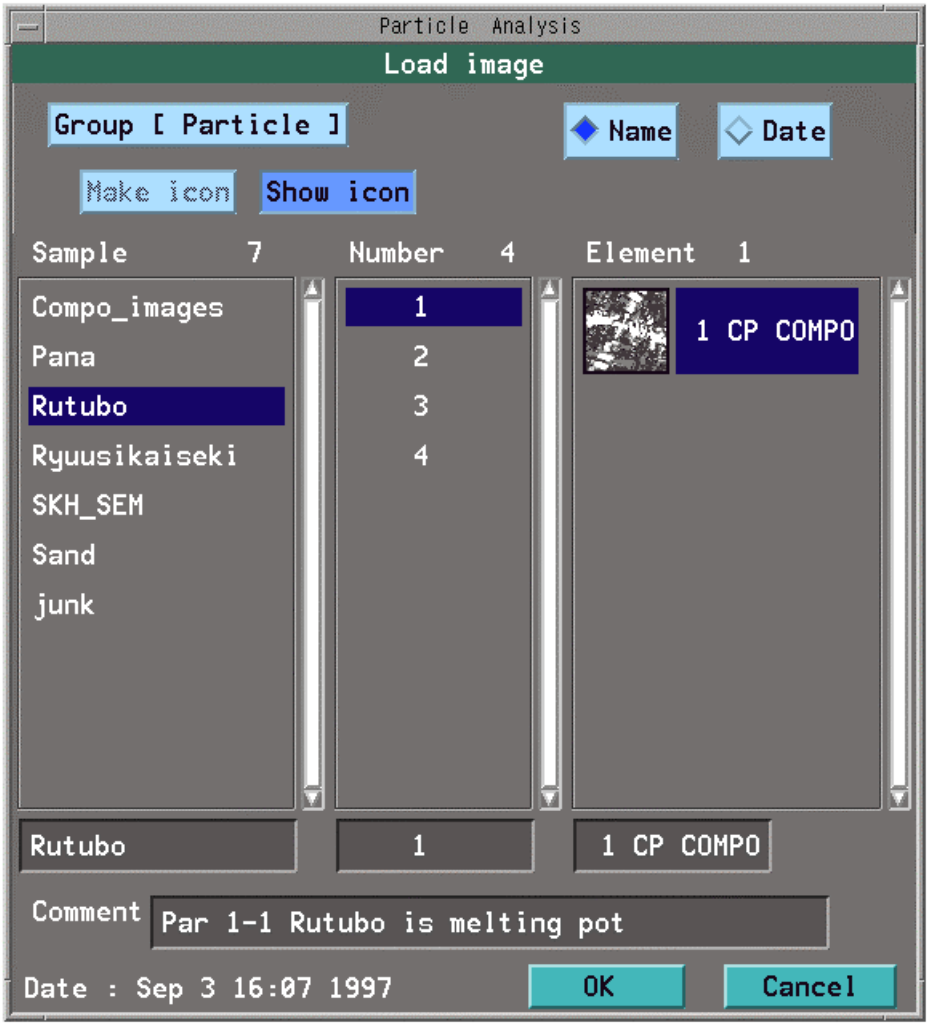


Fig. 5.4 “Load Image” window

5.4 Save Image

Select “Save Image” from the “File” menu shown in Fig. 5.1, and the “Save image” window will be displayed as shown in Fig. 5.5. Click on the “OK” button in the “Save Image” window, and the “Confirm” window will be opened.
When you click on the “OK” button in the “Confirm” window (as shown in Fig. 5.5), the sample name is “Rutubo” and it will be saved as sample number Number 2. The element is added to the last of the existing elements. However, when you add an element to the existing file of elements, the number of pixels of the image to be saved must be consistent with the number of pixels of the file. It is possible to save up to 30 elements.

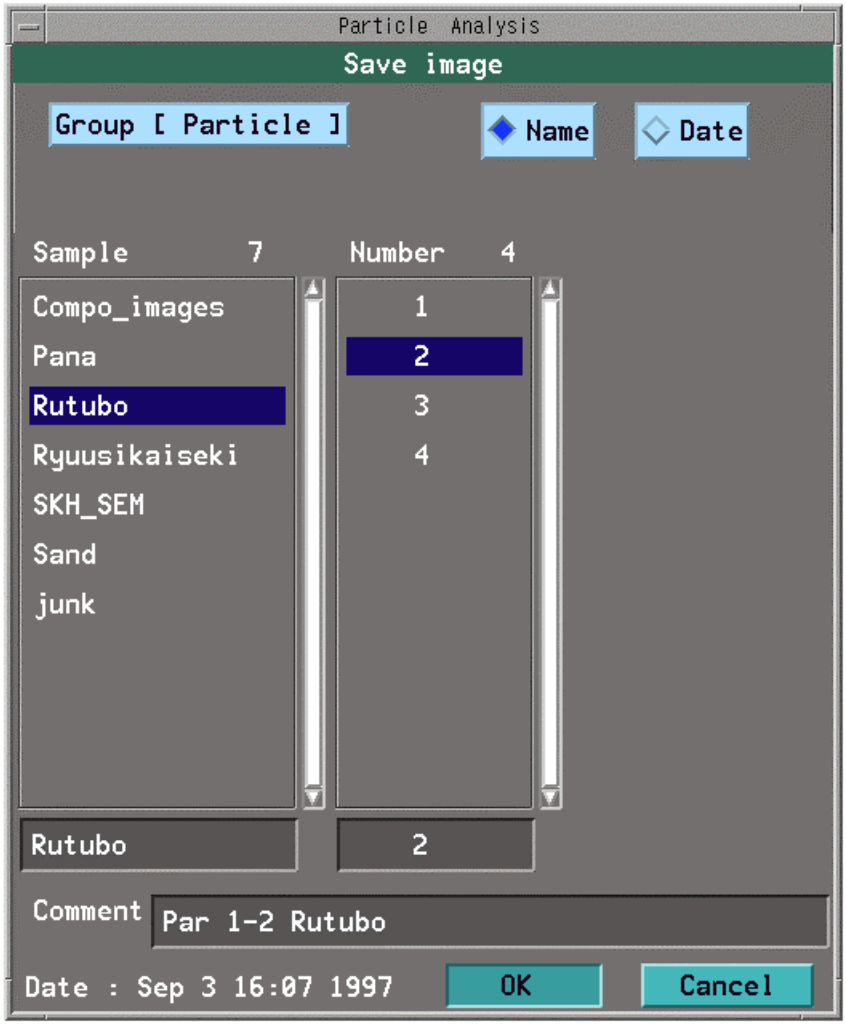
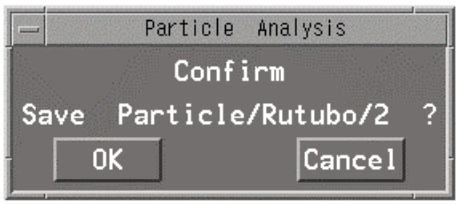


Fig. 5.5 “Save Image” window



5.5 Delete Image

Select “Delete Image” from the “File” menu shown in Fig. 5.1, and the “Delete image” window will appear as shown in Fig. 5.6. Click on the “OK” button in the “Delete image” window, and the “Confirm” window will be opened.
When you click on the “OK” button in the “Confirm” window in the example of Fig. 5.6, the image of the sample name “Rutubo” Number 2, Element 2 will be deleted.

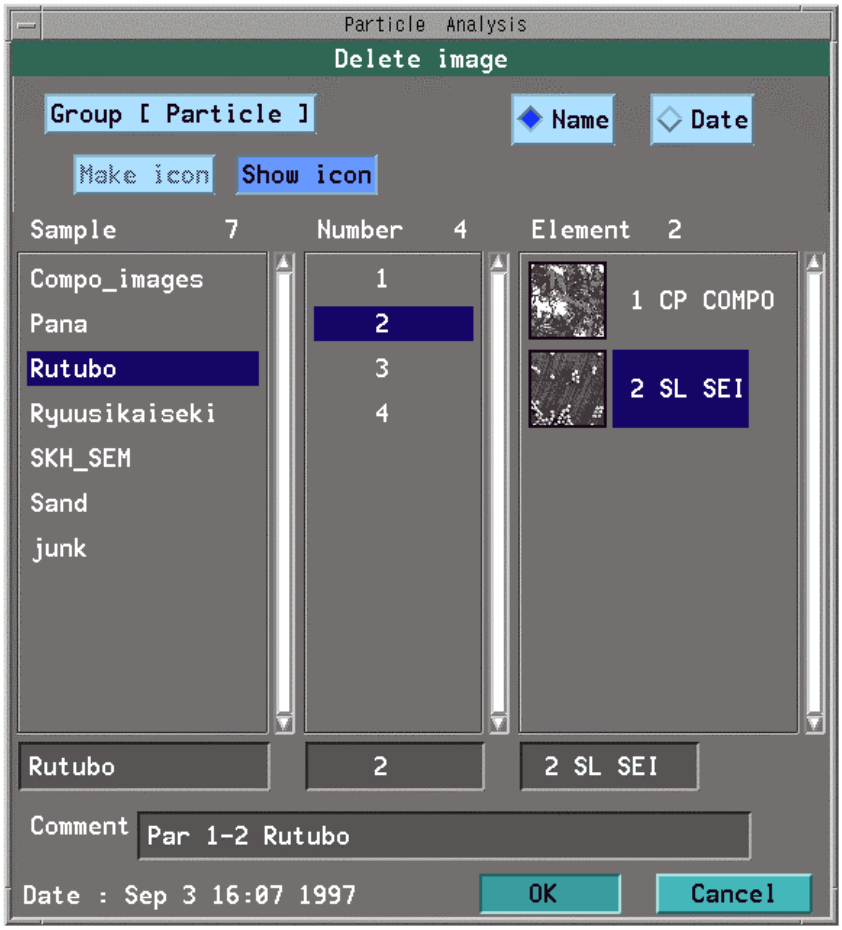
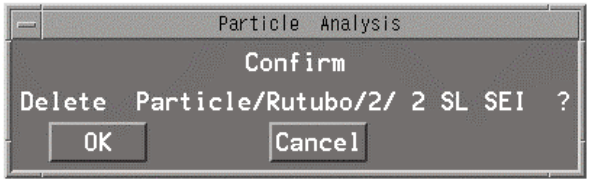


Fig. 5.6 “Delete image” window



5.6 Exit

Select “Exit” from the “File” menu shown in Fig. 5.1, and the automatic particle analysis will finish, and then the relevant windows will be closed. However, the measurement window will not be closed. If the measurement is in process, click on the “Stop” button in the “Measurement monitor” window.

6 OPERATION

Click on “Operation” on the menu bar shown in Fig. 4.1, and the pull-down menu will be displayed as shown in Fig. 6.1.
Processing is performed for the current image. The following processing operations can be executed.

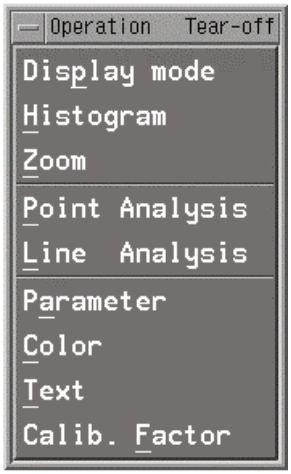


Fig. 6.1 “Operation” pull-down menu

6.1 Display Mode

Select “Display mode” from the “Operation” pull-down menu shown in Fig. 6.1, and the “Display mode” window will appear as shown in Fig. 6.2.
In this window, you can control window size, intensity or concentration, color or monochrome, number of display colors, place where to display color bar or micron marker and mesh display.

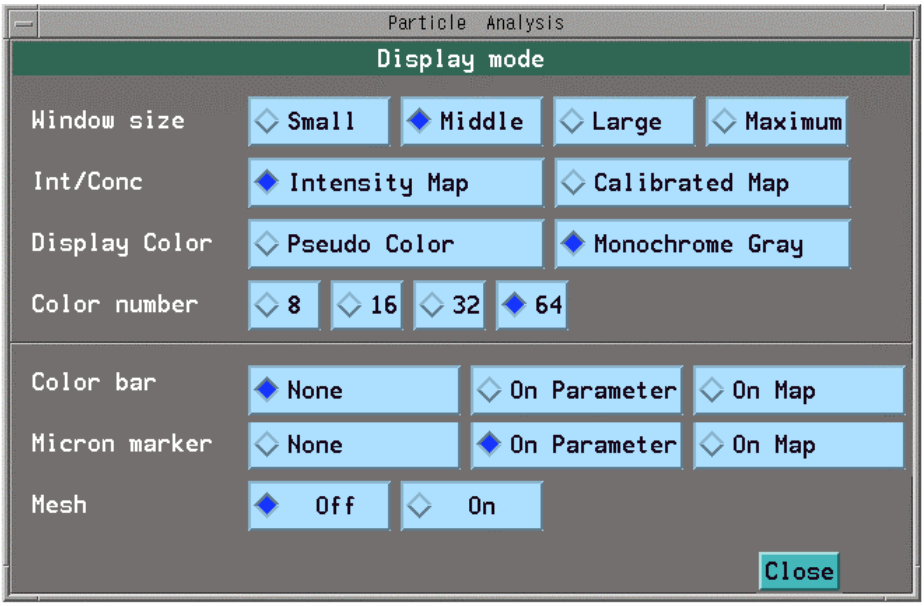


Fig. 6.2 “Display mode” window

You can change the image size by selecting “Small,” “Middle,” “Large” or “Maximum” at the right of “Window size”. Also, the size of the image can be changed arbitrarily by dragging the bottom right corner of the window shown in Fig. 4.1.

In the “Int/Conc” selection box, you can specify “Intensity Map” or “Mean Atomic-number Map” in the “Calibration Factor” window if the parameters A and B have been specified.

In the “Display Color” selection box, you can specify “Pseudo Color” or “Monochrome Gray.” However, “Pseudo Color” is automatically selected for an image labeled with the particle analysis function.

From the “Color number” selection box, you can select the number of display colors (number of levels). Select 8, 16, 32 or 64 colors.

From the “Color bar” selection box, you can select the display position of the color bar. When you click on the “None” button, the color bar is not displayed. When you click on the “On Parameter” button, the color bar is displayed on the parameter window. When you click on the “On Map” button, the color bar is displayed on the right edge of the image.

From the “Micron marker” selection box, you can select the display position of the micron marker. When you click on the “None” button, the micron marker is not displayed. When you click on the “On Parameter” button, the micron marker is displayed on the parameter window. When you click on the “On Map” button, the micron marker is displayed at the bottom left of the image.

In the “Mesh” selection box, you can turn on and off the display of the mesh. The color of the mesh to be displayed can be specified in the “Color” window.

6.2 Histogram

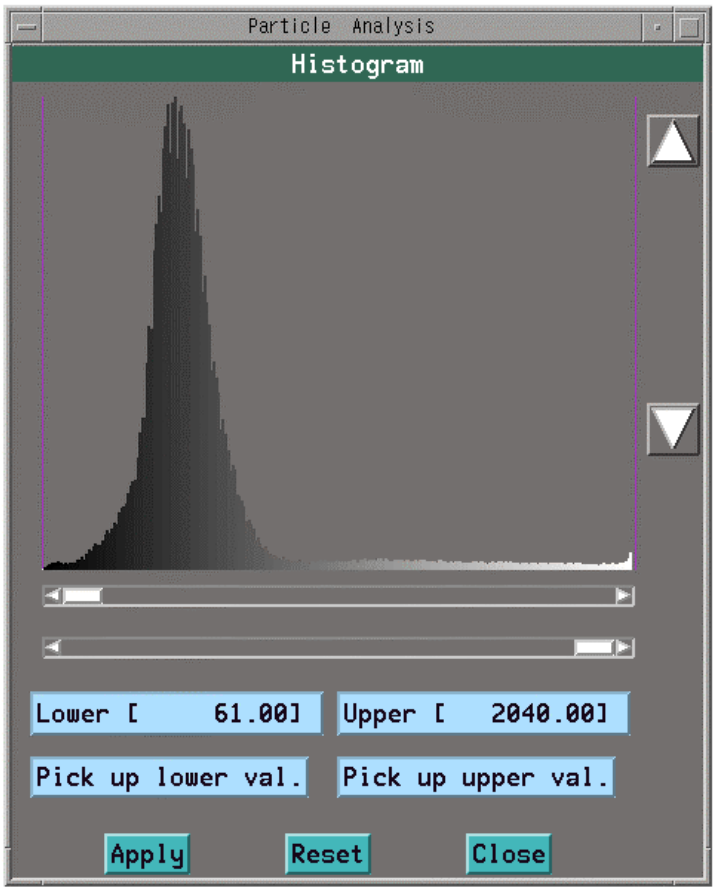


Fig. 6.3 “Histogram” window

Select “Histogram” from the “Operation” pull-down menu, and the “Histogram” window will be opened as shown in Fig. 6.3.
The window displays a histogram that is equally divided into 256 sections between the minimum and maximum values. The color level equally divided into 8, 16, 32 or 64 colors between the minimum and maximum values is displayed. The histogram is enlarged or reduced when the arrow keys ▲▼ located on the right-hand side of the histogram are pressed.

A new image having new levels is displayed by dragging the scroll bar and keying in the “Lower” and “Upper” values. By dragging the scroll bar, the color does not change while you are dragging the scroll bar, but it changes when you release the mouse button.

You can read an arbitrary pixel value on an image using the “Pick up lower val.” and “Pick up upper val.” buttons and specify it as the minimum or maximum value. To use them, highlight these buttons and click on the image. The pixel value at that position will be shown on the scroll bar.

When you click on the “Apply” button, level dividing is determined. Clicking on the “Cancel” button cancels the level dividing and returns the window to the previous window.

6.3 Zoom

Select “Zoom” from the “Operation” pull-down menu, and the “Zoom” window will be displayed as shown in Fig. 6.4.
There are two methods for zooming. One is to enlarge part of an image centered on the specified point by specifying the magnification desired (this method is called “Center”) and the other is to drag the mouse over the area you want to enlarge (this method is called “Outline”).

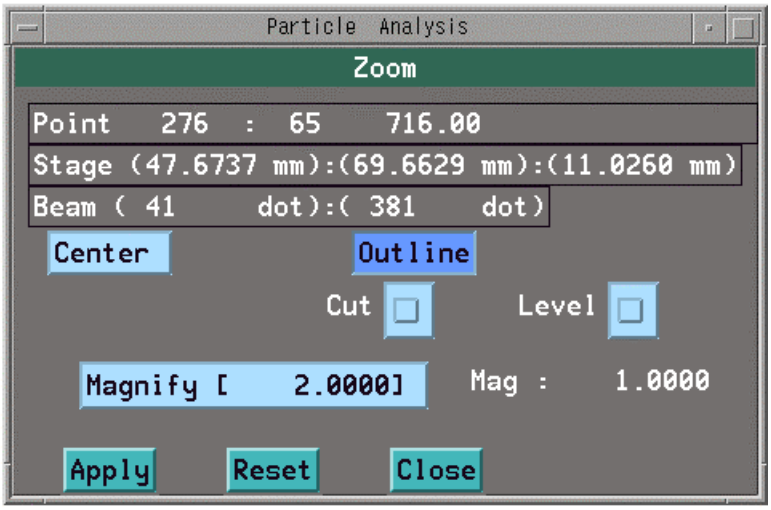


Fig. 6.4 “Zoom” window

When you select the “Center” button, click on the position of the image you want to display and click on the “Apply” button, the current image is enlarged, centered on that position, by the factor shown in the “Magnify” selection box. On the other hand, when you click on the “Outline” button, designate the area of the image you want to enlarge with the rubber band of the mouse and click on the “Apply” button, the designated area is enlarged.

The “Cut” button is in effect when you select the “Outline” button. Its function is to displays the outside of the rubber band as having no data. Click on the “Level” button to re-calculate the maximum and minimum levels from the displayed image and display the re-calculated image. You cannot see the relation of colors with the previous image (prior to being enlarged) any more, but you can see much more detail of the color distribution.

6.4 Parameter

Select “Parameter” from the “Operation” pull-down menu, and the “Display Parameter” window will be displayed as shown in Fig. 6.5.
When you click on any item you want to display, the parameter corresponding to the selected item will be displayed on the “Parameter” window. When you want to remove it from the display, click on it again. To turn the color bar and micron marker on or off, click on “On” or “Off” in the “Display Mode” window. When you click on the “Apply” button, the selected items are displayed on the “Display Parameter” window.

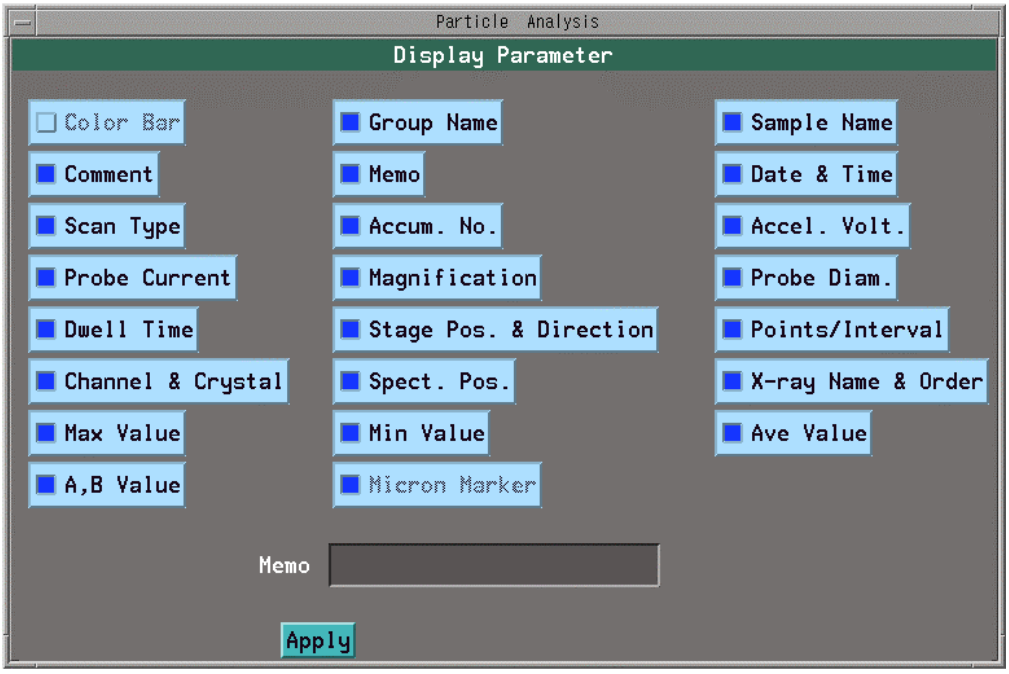


Fig. 6.5 “Display Parameter” window

6.5 Color

Select “Color” from the “Operation” pull-down menu, and the “Parameter Color” window will be displayed as shown in Fig. 6.6.

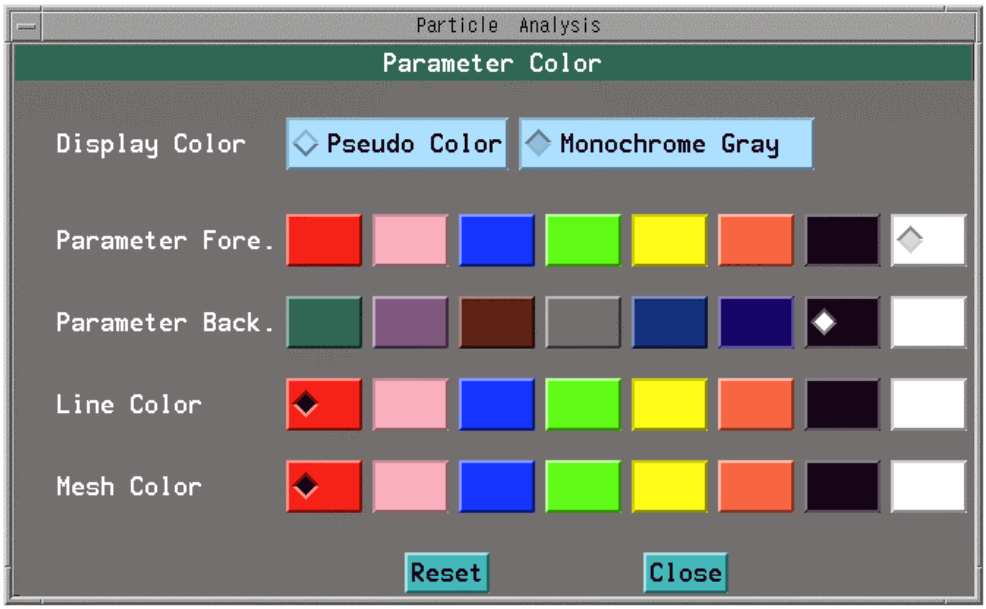


Fig. 6.6 “Parameter Color” window

From the “Display Color” selection box, you can select pseudo color or gray scale. In the “Parameter Fore.” and “Parameter Back.” selection boxes, you can select the parameter-character color and parameter-background color respectively. These colors are used to display the “Parameter” window and micron marker.

From the “Line Color” selection box, you can select the green color for line analysis. This color is also used as the mark color for point analysis. In the “Mesh Color” selection box, you can select the color to display the mesh.

6.6 Text

Select “Text” from the “Operation” pull-down menu, and the “Write Text” window will be displayed as shown in Fig. 6.7.

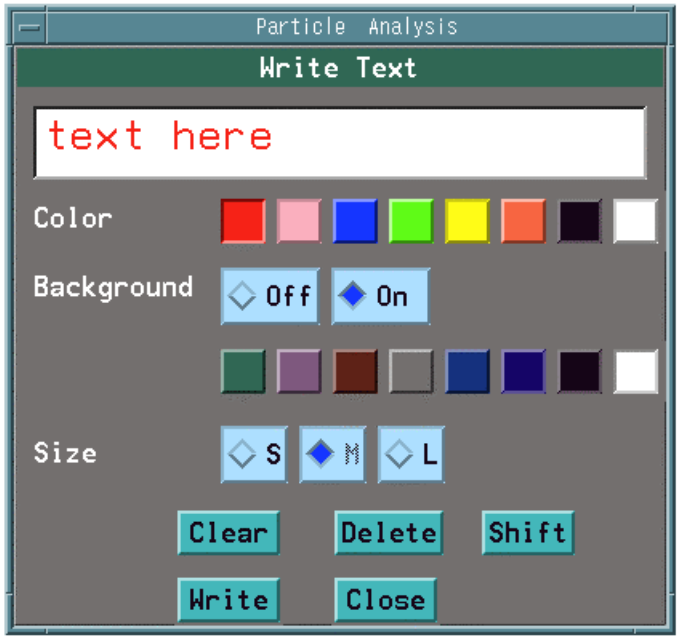


Fig. 6.7 “Write Text” window

When you want to display text on the image, first, click on a position on the image. Then, input text in the “Write Text” window. When you want to attach a background color, select “On” from the “Background” selection box and then select a background color. When changing the letter size, select “S,” “M” or “L.” Clicking on the “Write” button will display the text on the image. When you want to change the position of the displayed text, click on the “Shift” button and then drag the text on the image. After the text is shifted, do not forget to release the “Shift” button.

The “Clear” button is used to erase the text from the “Write Text” window. When you want to erase the text that has already been displayed on the image, use the “Delete” button. Clicking on this button will display a list of displayed texts. Selecting the text you want to delete will delete that text from the display screen.

6.7 Calibration Factor

Select “Calib. Factor” from the “Operation” pull-down menu, and the “Calibration Factor” window will be opened as shown in Fig. 6.8.
You can input the parameters A and B to convert a raw image to a mean atomic number image in this window. If the parameter A is 0, the mean atomic number is not converted.

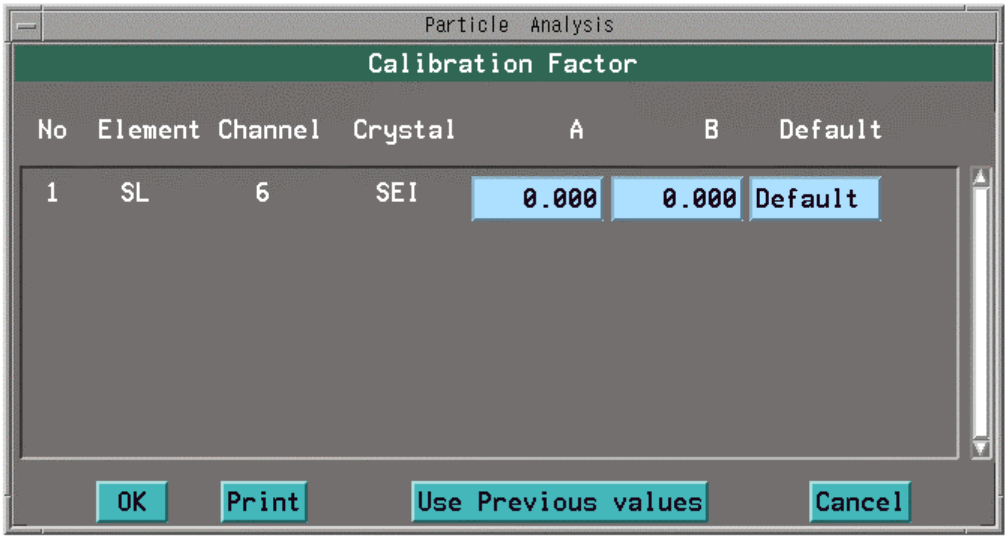


Fig. 6.8 “Calibration Factor” window

The parameters A and B can be obtained by executing “Calibration” on the “Signal Condition” window in the Analysis menu (refer to Sect. 8.1.3). If “Calibration” has been performed, click on the “Default” button and the calibration result will be displayed. If the parameters A and B have already been input, click on the “Use Previous values” button to use the input values.

6.8 Point Analysis

Select “Point Analysis” from the “Operation” pull-down menu, and the “Point Analysis” window will be displayed as shown in Fig. 6.9.
The Point Analysis function enables you to measure the intensity at the desired point on the image, move the stage and the beam, and display the coordinates of the analysis point on the image.

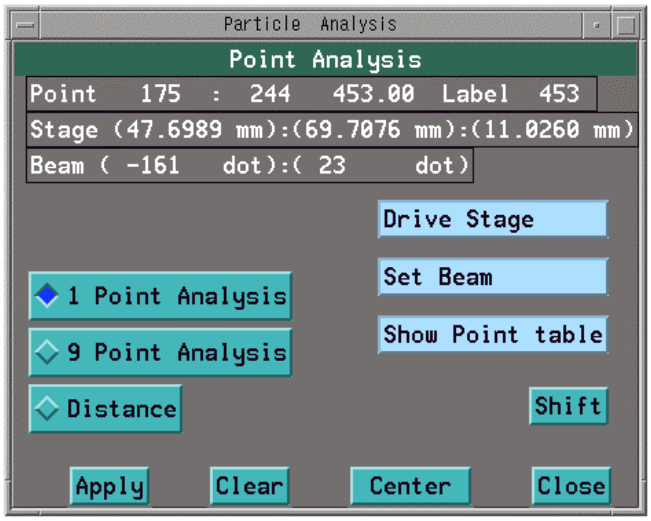


Fig. 6.9 “Point Analysis” window

When you click or drag the mouse on the image, the stage position, beam position and beam intensity at that position will be displayed in the parameter display located at the top of the window.

After clicking on the image, select “Drive Stage”, and the stage will move to that position. Selecting “Set Beam” will move the beam to the specified position. Use the “Center” button located at the bottom of the window to move the stage to the center of the image. When you want to confirm the analysis point after the measurement, move the stage to the center of the image by clicking on the “Center” button.

By clicking on the “Show Point table” button, you can display the point analysis coordinates that are superposed on the image. In this case the “Coordinates” window shown in Fig. 6.10 is displayed at the same time. When you want to correct any coordinates displayed, click on the “Shift” button and drag the coordinates on the image.

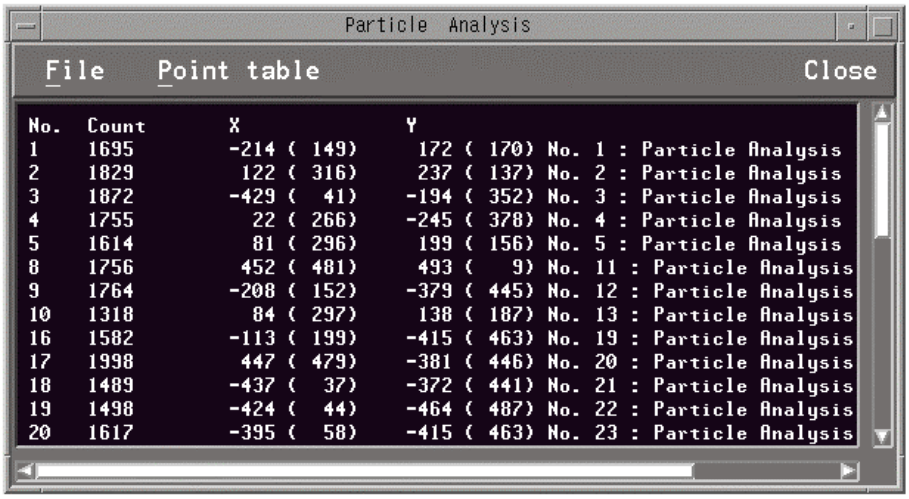


Fig. 6.10 “Coordinates” window

The “1 Point Analysis” and “9 Point Analysis” buttons are used to display the intensity at the specified point and the average value of 9 points around the specified point respectively. After clicking on a position on the image, click on the “Apply” button and these results will be displayed on the “Coordinates” window shown in Fig. 6.10. To display the distance between two points on the image, select “Apply” after dragging on the image.

To change the point-analysis coordinates table to reflect these results, select “Point Table” in the “Coordinates” window (Fig. 6.10) and the “Coordinates Conversion” window (Fig. 6.11) will appear. The “Update” button is used to correct the coordinates table. In practice, first, display the point-analysis coordinates by clicking on the “Show Point table” button; next, change the analysis coordinates using the “Shift” button; then click on this “Update” button. The “Append” button is used to add some more coordinates to the point-analysis coordinates table. The “New” button is used to replace the existing coordinates table with a new coordinates table.
If “Beam” is selected in the “Type” selection box when you save a new coordinates table, the beam coordinates to which the new coordinates have been converted are saved. If “Stage” is selected, the X, Y stage positions to which the new coordinates have been converted are saved.

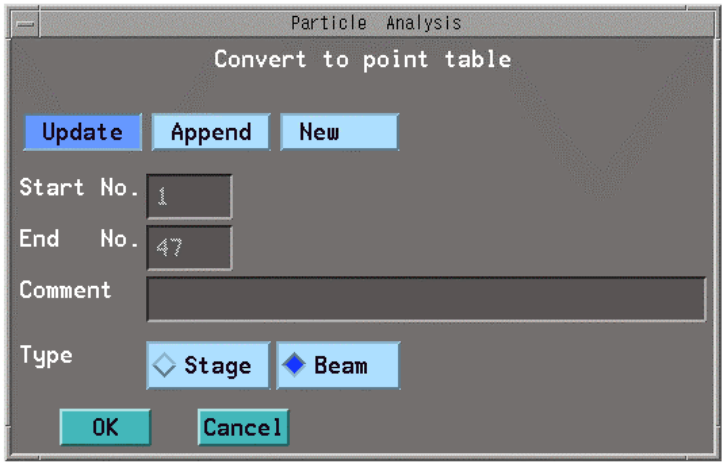


Fig. 6.11 “Coordinates Conversion” window

When you want to erase the results of the point analysis or the distance from the display screen, click on the “Clear” button and the “Coordinates Clearance” window will be displayed as shown in Fig. 6.12. Clicking on any item listed will erase that item. To erase all the listed items, click on the “Clear All” button. Bear it in mind, however, that the “Clear ALL” function only deletes the display from the display screen and does not change the coordinates table.

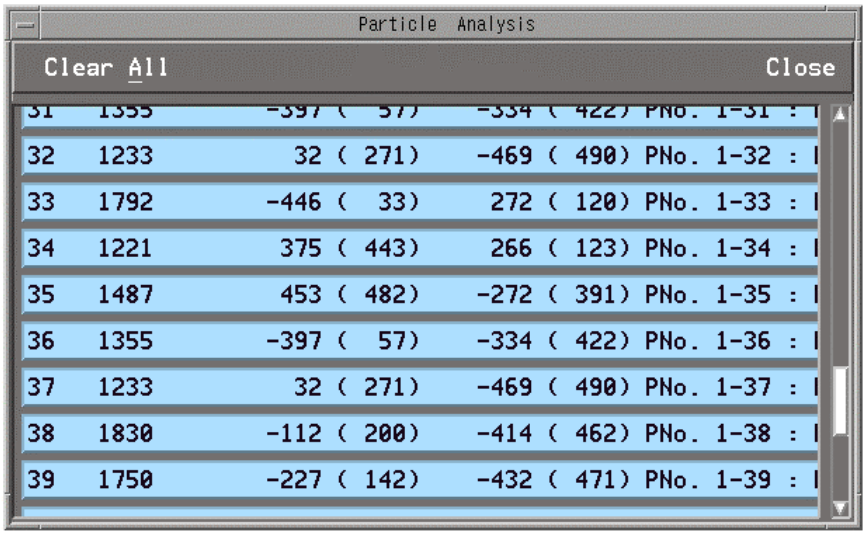


Fig. 6.12 “Coordinates Clearance” window

6.9 Line Analysis

Select “Line Analysis” from the “Operation” pull-down menu and the “Line Analysis” window will be displayed as shown in Fig. 6.13. You can perform line analysis in the horizontal, vertical or desired directions.

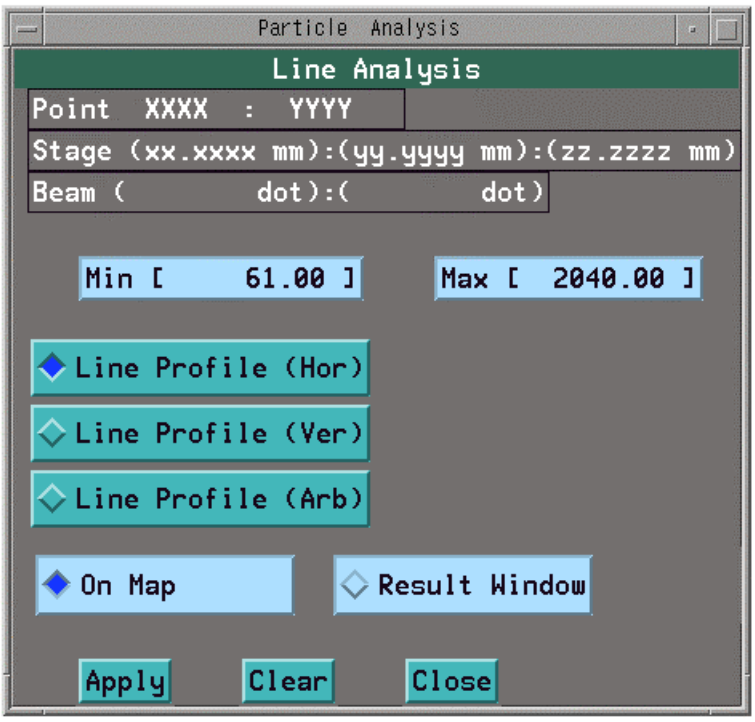


Fig. 6.13 “Line Analysis” window

To perform line analysis in the horizontal direction, select “Line Profile (Hor)”; click on the image and drag the mouse continuously to determine the measurement width. When determining the measurement area, select the “Apply” button. If “On Map” is selected, the line analysis results that are superimposed on the image will be displayed. If “Result Window” is selected, the analysis results will be displayed in another window.

To perform line analysis in the vertical direction, select “Line Profile (Ver)”; then repeat the same operations as described above.

To perform line analysis in an arbitrary direction, select the “Line Profile (Arb)” button; next, click on the image to determine the center of the line; then, drag the mouse continuously to determine the direction of line analysis. When determining the direction, drag the mouse again to determine the measurement width. Clicking on the “Apply” button will display the line analysis results.

To set the minimum and maximum values of the line analysis results, click on the “Min” and “Max” buttons. Then, you can adjust the amplitude of the line profile display.

To erase the line analysis results, select “Clear.”

7 PARTICLE ANALYSIS

To carry out automatic particle analysis, it is necessary to set the procedures for particle analysis. For that reason, execute particle analysis in the “Auto” window.

To perform simple particle analysis, carry out image data analysis according to the following procedures. The menu items in the “Particle” pull-down menu are indicated in parentheses.

- Binarization of image data (Binarize)
- Labeling of a binarized image (Labeling)
- Measurement of labeled particles (Measurement)
- Saving the center of gravity of a particle in the coordinates table (Save stage)

To perform somewhat complicated particle analysis, carry out image data analysis according to the following procedures. Of course, you sometimes have to change the procedures depending upon the state of the specimen.

- Pre-processing of image data (Filter)
- Binarization of image data (Binarize)
- Labeling of a binarized image (Labeling)
- Correction of a labeled image (Binary Filter)
- Removal of unnecessary particles (Delete)
- Measurement of labeled particles (Measurement)
- Saving the center of gravity of a particle into the coordinates table (Save stage)

  In order to execute elemental analysis after performing particle analysis it is absolutely necessary to save the center of gravity of found particles in the coordinates table.

Click on “Particle” on the menu bar shown in Fig. 4.1, and the pull-down menu will be displayed as shown in Fig. 7.1.
Particle analysis can be performed for the current image. The following processing can be executed.

Fig. 7.1 “Particle” pull-down menu

7.1 Auto

Select “Auto” from the “Particle” pull-down menu, and the “Auto” window will be displayed as shown in Fig. 7.2.
Set the procedure for particle analysis in this “Auto” window.

There is a menu bar indicating “File,” “Edit,” “Run,” “Reset” and “Close” on the top of the window. Menu buttons for particle analysis are shown on the left-hand side of the window. The buttons for the menu items that cannot be executed are indicated in a dim color.

☞ For details of the menu items, refer to Sect. 7.2 and the subsequent sections.

Shown on the right-hand side of the window is a list of particle analysis conditions that have been set. There is an On/Off toggle button on the left-hand side of each listed item. Only the listed items that have been selected with the toggle buttons are executed in particle analysis.

When you first use the “Auto” function, select “New” from the “File” menu and then start particle analysis. The particle analysis commands executed immediately after “New” is selected are unconditionally added to the list. When you want to change the particle analysis conditions that have been established, click on one of the listed items and then click on “Edit.” Then, the “Replace command ?” confirmation window is displayed. When you want to insert a command into the list, click on the listed item that is just above the line in which you want to insert the command and click on “Insert” in the “Edit” menu. You can delete unnecessary items from the list by clicking on the “Delete” button in the “Edit” menu.

When you select “Run,” the listed items are executed one after another, from top to bottom. The command that is being executed is highlighted. To go back to the original image, click on the “Reset” menu.

There is another method for performing particle analysis. Select one of the listed items and then select “Single.” In this case, only the selected command is executed. Double-clicking on the listed item automatically executes the “Single” command.

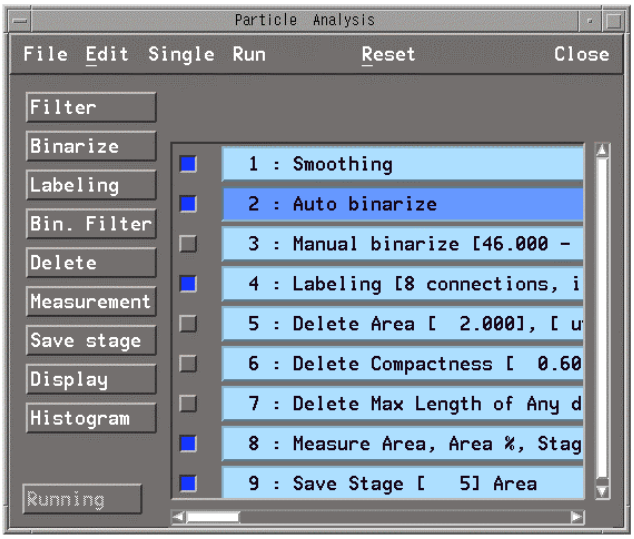


Fig. 7.2 “Auto” window

The following is the explanation of the “File” pull-down menu.

New:	Allows you to erase the existing commands and make new conditions.
Load auto conditions:	Allows you to read condition files that have been saved.
Save auto conditions:	Allows you to save the conditions with comments attached.
Delete auto file:	Allows you to delete unnecessary files from the saved condition files.
Close window:	Allows you to close this window.

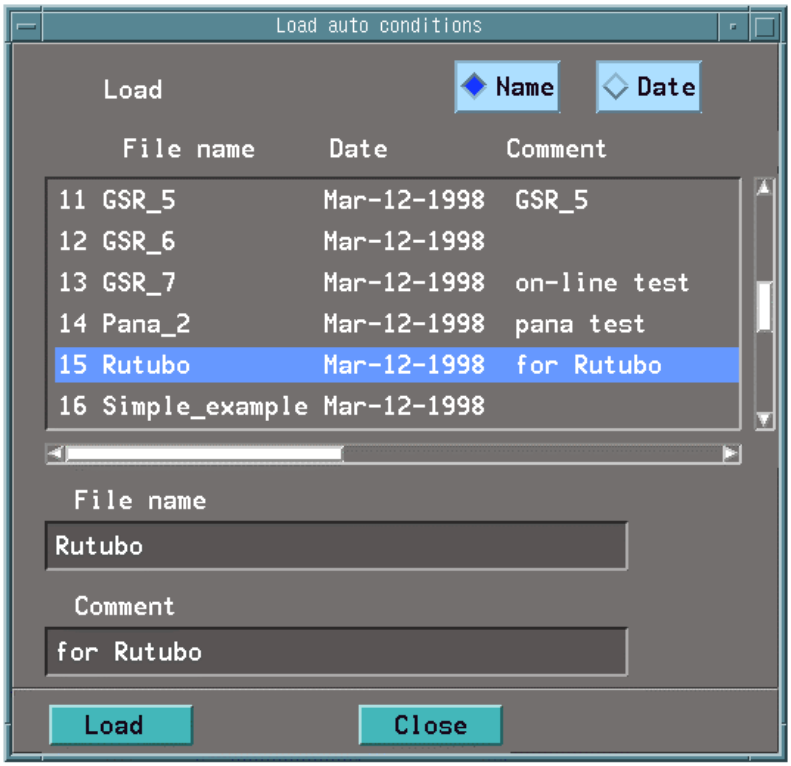


Fig. 7.3 “Load auto conditions” window

The following is the explanation of the “Edit” pull-down menu.
Click on one of the listed items in order to select the “Edit” menu. Then you can correct the selected command.

Edit:	Allows you to correct the contents of the selected listed-item. When you select “Edit,” the command-operation window will be displayed. Operate the commands and click on the “Apply” button; then the “Replace command ?”confirmation window will be displayed. If you want to replace the command, click on the “OK” button. If you want to keep the command unchanged, click on the “Cancel” button.
Copy:	Allows you to store the selected listed-item in the internal buffer. The listed item remains as it is.
Delete:	Allows you to erase the selected listed item. The erased listed item is stored in the internal buffer.
Paste:	Allows you to additionally insert the contents stored in the internal buffer just below the selected listed-item.

Insert:	Allows you to make an extra line just below the selected listed item. Is used to add an item to the list. After clicking on “Insert,” select this extra line; click on “Edit” and enter the contents to the line.

The following is the explanation of the “Single” pull-down menu.
This menu can be used only when one of the listed items is selected. When it is selected, only the selected items are executed.

The following is the explanation of the “Run” pull-down menu item.
This menu, when selected, returns the current image to its original image (regardless of the current image) and executes the items in the list one after another in the order from the first item down to the last in the list.

The following is the explanation of the “Reset” pull-down menu

Reset to original map:	Allows you to cancel the particle analysis results and returns the current image to its original image.
Reset to original binary:	Allows you to return the current image to the first binarized image. Normally, this function is used to cancel “Binary Filter.”
Return to original label:	Allows you to return the current image to the image when it had just been labeled. Normally, this function is used to cancel “Delete.”
Return to original condition:	Allows you to return the particle analysis conditions to those which appeared when the window wass opened.

7.2 Run Auto

Click on “Run auto” in the “Particle” pull-down menu shown in Fig. 7.1, and a series of particle analysis commands shown in Fig. 7.2 (“Auto” window) will be executed.
You can get the same result by clicking on the “Run” button in the “Auto” window shown in Fig. 7.2.

7.3 Particle Undo

“Particle Undo” in the “Particle” pull-down menu shown in Fig. 7.1 has a sub-menu consisting of “Original map,” “Binary map” and “Label map.” The current image is returned to its original image, binarized image or labeled image when you select one of them.

Original map:	Cancels the particle analysis results and returns the current image to its original image.
Binary map:	Returns the current image to the first binarized image.
Label map:	Returns the current image to the image when it had just been labeled.

7.4 Filter

Select “Filter” from the “Particle” pull-down menu, and the “Filter” window will be displayed as shown in Fig. 7.4. You can improve the image quality using this window. Select one of the following menu buttons to execute the menu item.

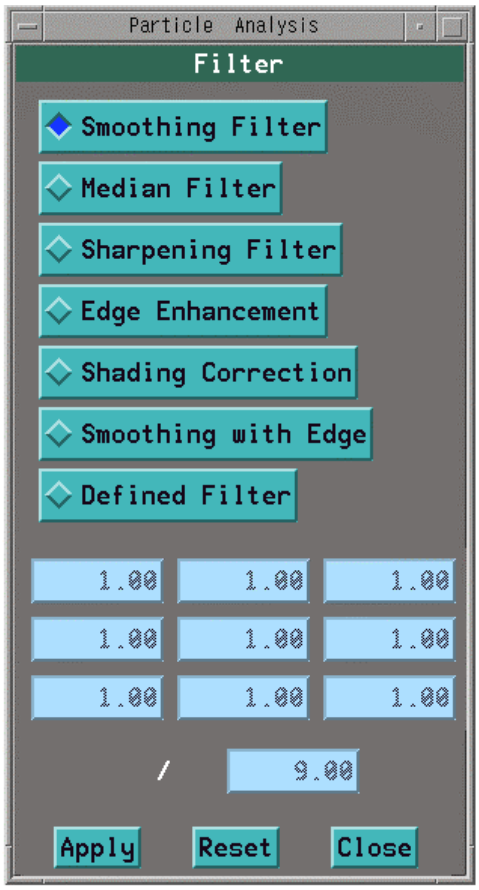


Fig. 7.4 “Filter” window

Smoothing Filter: Allows you to perform smoothing without 3 × 3 weighting.

Median Filter: Allows you to replace the value of each point with the 5th largest (center value) of 9 points.

Sharpening Filter: Allows you to perform 3 × 3 filtering for sharpening an image.

$$\begin{bmatrix} 0, -1, & 0 \\ -1, 10, & -1 \\ 0, -1, & 0 \end{bmatrix} \Big/ 6$$

Edge Enhancement: Allows you to replace the value of each point by |b1| + |b2|, which is the sum of the absolute value of b1 and the absolute value of b2 in order to enhance the edge of an image,
Where the nine points are labeled

A	B	C
D	E	F
G	H	I

and
b1 = A + 2B + C – G – 2H – I,
b2 = A + 2D + G – C – 2F – I.

Shading Correction: Used to perform Ohtsu's discrimination analysis for each subdivision. Shading correction takes place on the spline curve that passes through a row of dots representing the threshold value. In some cases, the calculation takes several minutes.

Smoothing with Edge: Allows you to perform smoothing while retaining edges. Replaces the value of each point with the average value of the 5 × 5 pattern that has the lowest standard deviation of the nine types of 5 × 5 patterns used.

Defined Filter: Allows you to define an arbitrary 3 × 3 filter and perform weighting calculation.

7.5 Binarize

Select "Binarize" from the "Particle" pull-down menu, and the "Binarize" window will be displayed as shown in Fig. 7.5. You can binarize the data using the Binarize window. Click on one of the following menu buttons to execute the menu item.

Auto: Allows you to automatically perform binarization. When Ohtsu's discrimination analysis is performed, the threshold value level is determined.

Manual (Region): You can manually perform "region designation" in which a pixel is turned on (white) for the region from the Lower value to the Upper value and off (black) otherwise (refer to Fig. 7.6).

Manual (Threshold): You can manually designate a threshold. A pixel is turned on (white) if its value is greater than the Lower value and is turned off (black) if its value is less than the Lower value.

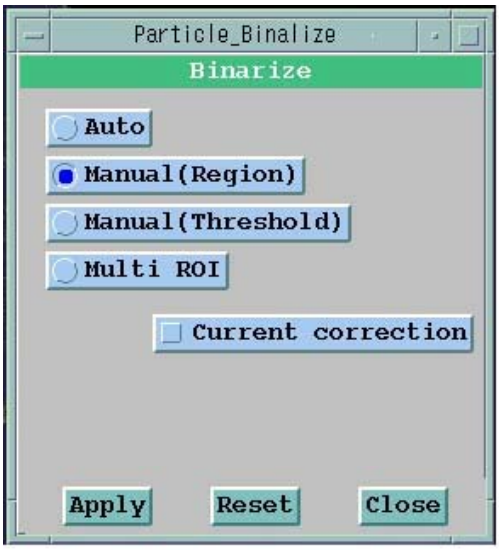


Fig. 7.5 “Binarize” window

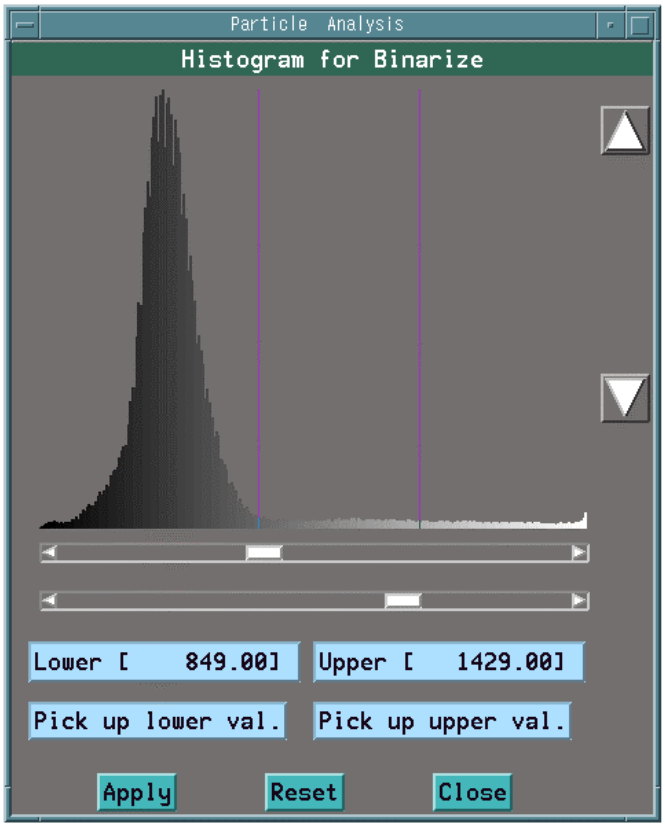


Fig. 7.6 “Histogram for Binarize” window used for manual binarization

7.6 Multi-level Coding Using Multi ROI Window

If you select Multi ROI in the Binarize window, you can identify the particles using multiple ROIs. In the Multi ROI window, you can color-code the intensity into up to seven levels. Level setting is carried out as follows:

1. Allocating the desired color to the ROI

When you click on the desired color button, the specified color is assigned to the active ROI, and three ROI setting markers appear to the right, in the center, and to the left of the ROI. You can change the range of the ROI by dragging the right-side marker or the left-side marker rightward or leftward. The marker in the center of the ROI is used for moving the entire ROI rightward or leftward.

2. Recording the ROI settings

Click on the Set button to record the above-mentioned ROI settings.

If you want to delete a ROI that has been set, select it, then click on the Unset button. If you click on the All ROI Clear button, you cancel all the settings of the recorded ROIs.

✍ Apart from the use of the Multi ROI window, you can specify the ROI directly using the image. To do this, click on the Pick up lower val. button or the Pick up upper val. button, then click on the point on the image that you want to make the lower or upper ROI limit. The signal intensities on this image are acquired, and the corresponding ROI range can be set on the Multi ROI window.

3. Using the Apply button

Click on the Apply button after completion of these ROI settings.

The results of multi-level coding are checked and displayed in the image display window for each color-coded ROI.

☞ Refer to Fig. 7.7 Multi ROI window.

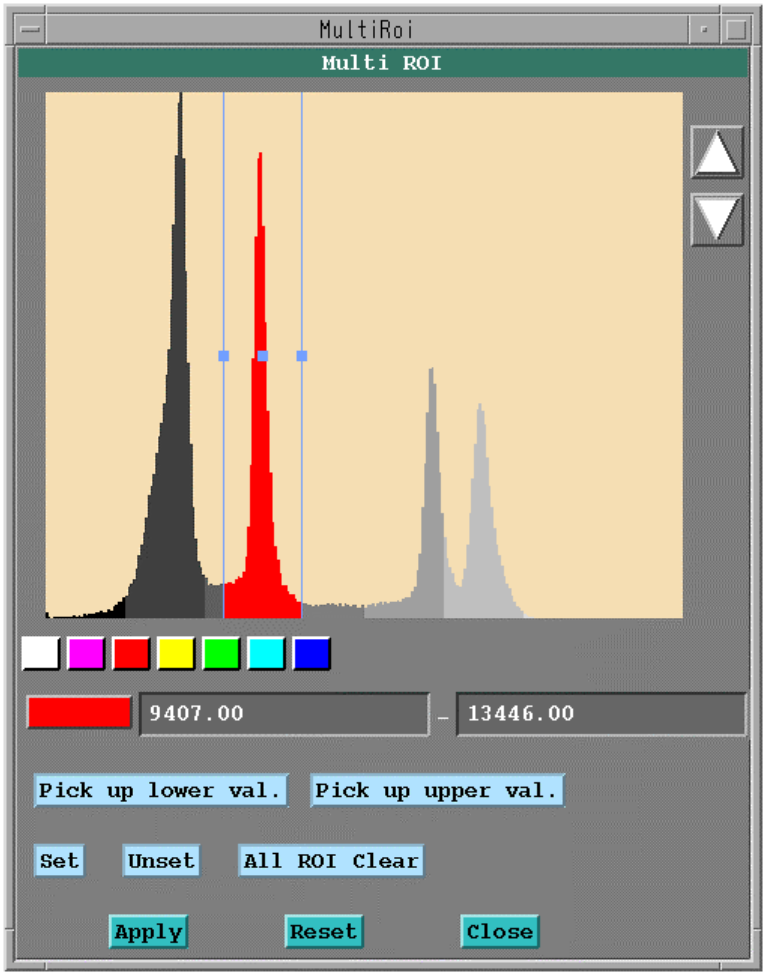


Fig. 7.7 Multi ROI window

- Later, you may need to process data by comparing with the multilevel-coded data. In preparation for such a need, select ROI # in the Measurement window in advance. Data on the corresponding ROI is saved as one of the results of particle analysis.
- If you intend to print the results only from the specified ROI after automatic particle analysis, set Sort in the Summary window to ROI#. You can set the ROI numbers of interest to Maximum and Minimum, allowing only the results of particle analysis for the desired ROI numbers to be printed.

7.7 Current Correction for Binarized Deviation

When binarizing the results of automatic particle analysis using the Binarize window, click on the Current correction button. The beam current used during the setting of analysis conditions is compared with the beam current used during data acquisition, and binarization is implemented with the beam current normalized to the value used during the setting of analysis conditions.

7.8 Labeling

Select “Labeling” from the “Particle” pull-down menu, and the “Labeling of Binarized Data” window will be displayed as shown in Fig. 7.8.
Labeling of binarized data is performed in this window. That is, each particle is numbered.

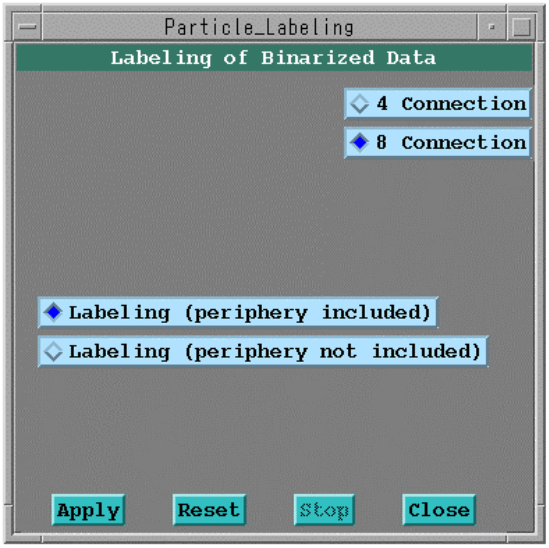


Fig. 7.8 “Labeling of Binarized Data” window

Click on one of the following buttons to execute the corresponding function.

- “4 Connection” button
- “8 Connection” button

When carrying out labeling, specify either “4 Connection” or “8 Connection.” If you select “4 Connection,” particle bonding is determined in the up-down and left-right directions without including diagonal directions. If you select “8 Connection,” particle bonding includes diagonal directions as well. In the case of complicated particles, it is recommended that “8 Connection” be used, because you can reduce the number of particles and also reduce the execution time.

- “Labeling (periphery included)” button
- “Labeling (periphery not included)” button

When performing the labeling of particles including peripheral particles, specify “Labeling (periphery included).” When performing the labeling of particles that do not include peripheral particles, specify “Labeling (periphery not included).”

When labeling has been executed, each particle is colored and displayed. The coloring of each particle, starting from the top left particle, corresponds to each color shown on the color bar.

7.9 Binary Filter

Select “Binary Filter” from the “Particle” pull-down menu, and the “Binary Filter” window will be displayed as shown in Fig. 7.9.
In this window you can perform filtering of a binarized or labeled image and correct the particles.

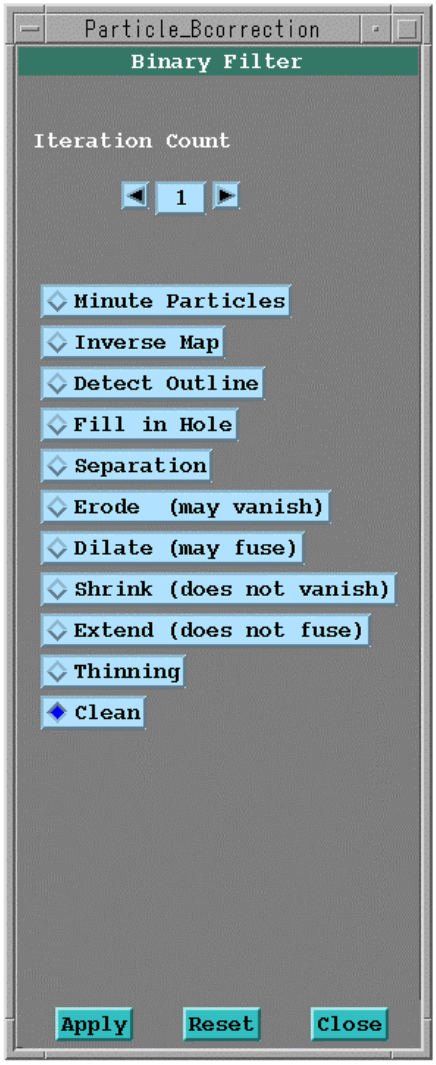


Fig. 7.9 “Binary Filter” window

“Iteration Count” buttons (◄ ►)

The numerical value between these two buttons ◄ ► is the number of iterations specified for filtering with the exception of “Inverse Map” and “Detect Outline.” Usually, it is set to a single-digit number.

Click on one of the following buttons to execute the corresponding function.

Minute particles:	Allows you to delete minute particles.
Inverse Map:	Allows you to reverse the black and white parts of an image.
Detect Outline:	Allows you to extract only the outline of particles.
Fill on Hole:	Allows you to fill in holes in particles.

Separation:	Allows you to separate particles.
Erode:	Allows you to erode particles. If all of a particle's pixels disappear as a result of eroding, the corresponding particle disappears.
Dilate:	Allows you to dilate particles. If two particles join due to dilation, they become one particle.
Shrink:	Allows you to shrink particles. The resulting number of particles does not change.
Extend:	Allows you to extend particles. The resulting number of particles does not change.
Thinning:	Allows you to make particles thinner.
Clean:	Allows you to erase something like an interference fringe that appears around a high-intensity area when you select the area during binarization.

7.10 Delete

Select “Delete” from the “Particle” pull-down menu, and the “Delete Particle” window will appear as shown in Fig. 7.10.

This window is used to delete binarized or labeled particles. Open this window and click or drag the mouse on the image. The particle number and the stage position will be displayed in the parameter display area located in the upper part of this window. After selecting any of particle measurement items, you can delete particles.

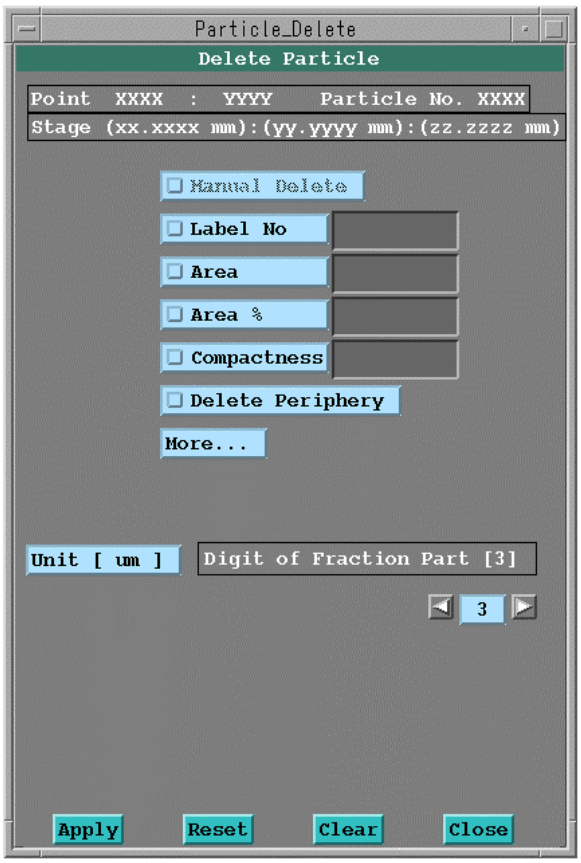


Fig. 7.10 “Delete Particle” window

Click on one of the following buttons to execute the corresponding function.

Manual Delete:	Click on the particles you want to remove and then click on the “Apply” button.
Label No [ ]:	Allows you to remove a particle corresponding to this number.
Area [ ]:	Allows you to remove particles that are smaller than this area. You can remove large particles by setting the area value to a negative value.
Area % [ ]:	Allows you to remove particles that are smaller than this area %. You can remove large particles by setting the area % to a negative value.
Delete Periphery:	Allows you to remove peripheral particles.

More. . .:	Allows you to specify the removal of particles according to other conditions. Clicking on the “More. . .” button will display the “Particle Delete” window as shown in Fig. 7.11.
Unit:	Allows you to specify the unit of an input numerical value. There are such units as Auto, Pixel, mm, μm and pm. Auto automatically selects either mm, μm or pm. Pixel indicates the number of pixels. Particularly, before entering a numerical value using Auto, it is recommended that you first measure particles according to Sect. 7.11 “Measurement” and confirm the unit used.
Digit of Fraction Part:	Allows you to specify the number of digits of input numerical values after the decimal point.

Click on the “More. . .” button in the “Delete Particle” window shown in Fig. 7.10 and the “Particle Delete” window will be displayed as shown in Fig. 7.11.

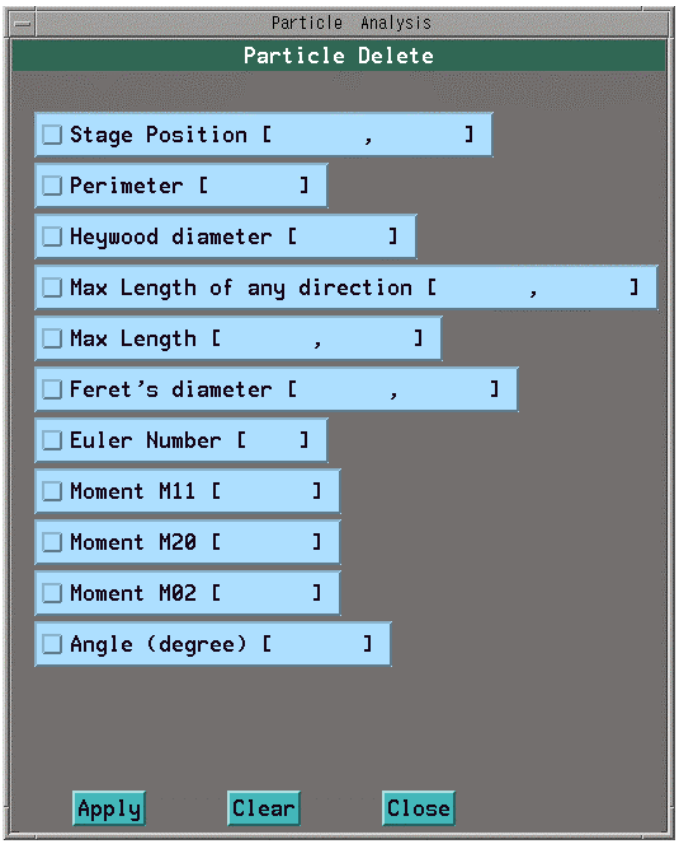


Fig. 7.11 “Particle Delete” window

You can also remove particles by specifying stage position, perimeter, compactness, Heywood diameter, maximum length in an arbitrary direction, maximum length in the X and Y directions, Feret’s diameter along the X and Y directions, Euler number, moments M11, M20, M02, and angle (degrees). Usually, you can remove particles that are smaller than the values specified here. If you enter a negative value, you can remove large particles in the same way as with the “Area” button.

Stage Position [,]:	You can remove particles at this stage position.
Perimeter [ ]:	You can remove particles that have a smaller perimeter than this value.
Compactness [ ]:	You can remove particles that have a smaller compactness than this value.
Heywood diameter [ ]:	You can remove particles that have a smaller Heywood diameter than this value.
Max Length of any direction [,]:	You can remove particles that have a smaller angular distance than this maximum length.
Max Length [,]:	You can remove particles that have a smaller length than this maximum length.*
Feret's diameter [,]:	You can remove particles that have a smaller diameter than this value.*
Euler Number [ ]:	You can remove particles that have a smaller number than this value.
Moment M11 [ ]:	You can remove particles that have a smaller moment M11 than this value.
Moment M20 [ ]:	You can remove particles that have a smaller moment M20 than this value.
Moment M02 [ ]:	You can remove particles that have a smaller moment M02 than this value.
Angle (degrees) [ ]:	You can remove particles that have a smaller angle than this angle to the main axis.

* Particles are removed when both of the X and Y values are sufficed.

7.11 Measurement

Select “Measurement” from the “Particle” pull-down menu, and the “Measurement of Labeled Data” window will be displayed as shown in Fig. 7.12.
If you click on the buttons corresponding to the measurement items, the measurement results are printed in the order in which you clicked on them.

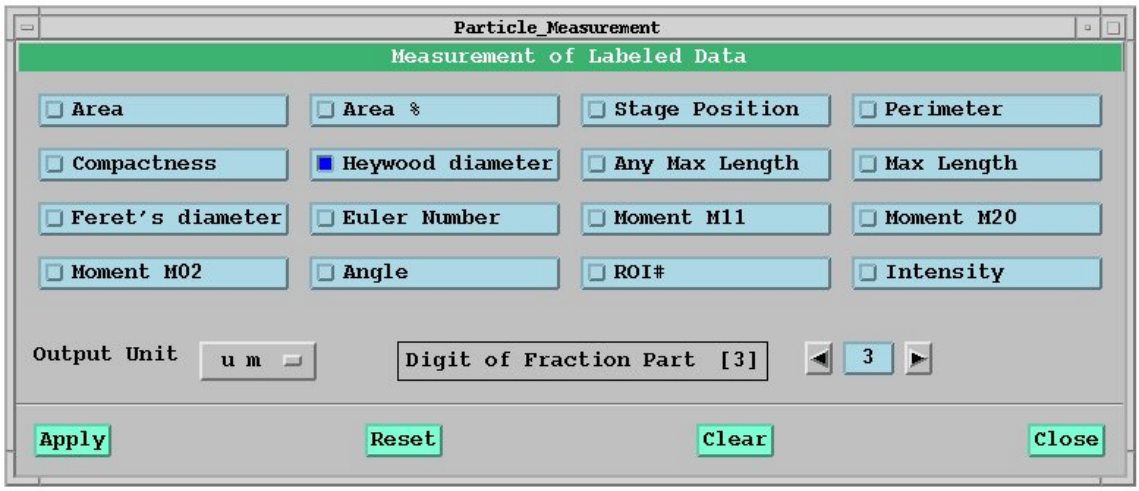


Fig. 7.12 “Measurement of Labeled Data” window

Click on the buttons corresponding to the items you want to print.

Area: Allows you to print the area of each particle. A particle consisting of one point only has an area of 1 pixel or 1 × (data point spacing in the X direction) × (data point spacing in the Y direction).

Area %: Allows you to print the area of each particle expressed as a percentage of all pixels.

Stage Position: Allows you to print the stage position [x, y] corresponding to the position of the center of gravity.

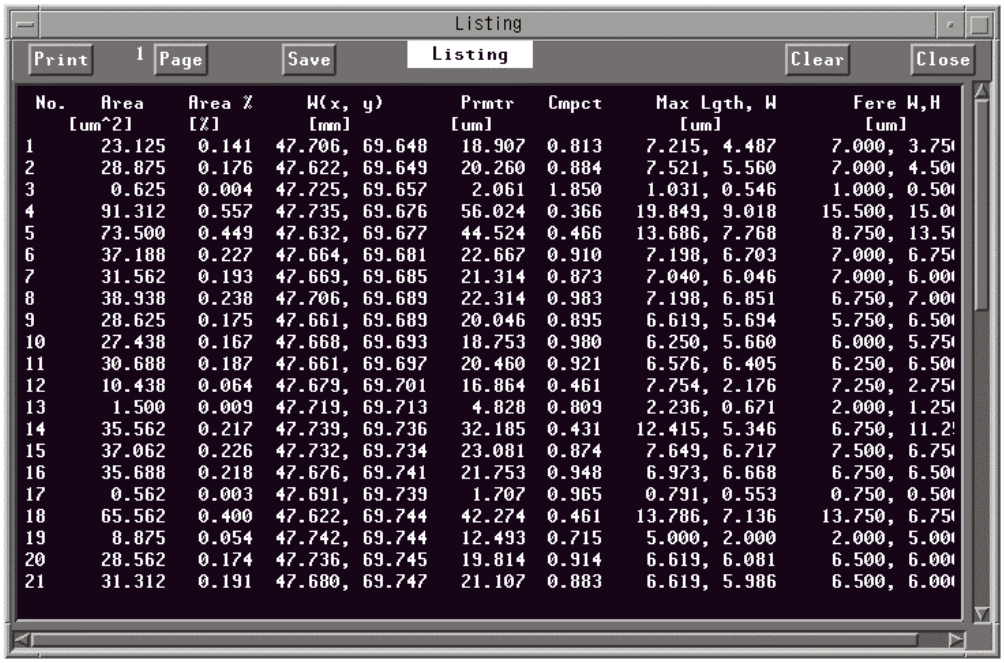
Perimeter: Allows you to print the perimeter. The perimeter of a particle consisting of one point only is 0. In computing the perimeter of a particle consisting two points or more, if there are two points in the X or Y direction, 1 is added, while if there are two points in an oblique direction, 1.41421 is added.

Compactness: Allows you to print the compactness.
Compactness = (4 ×π× Area) / (Perimeter × Perimeter).
The closer the particle is to a circle, the closer the compactness is to 1. A long thin particle has a small value in compactness. The compactness of a particle whose perimeter is 0 is calculated with the perimeter being 4.

Heywood diameter: Allows you to print the Heywood diameter.
Heywood diameter = $2 \times \sqrt{(\text{Area} / \pi)}$.

Any Max Length:	Allows you to print the maximum length in any direction and the width in the vertical direction.
Max Length:	Allows you to print the maximum lengths in the X and Y directions when the particle is scanned along the X and Y axes.
Feret's diameter:	Allows you to print the Feret's diameter [x, y]. Feret's diameter is the shortest length in the X and Y directions that can enclose a particle.
Euler Number:	Allows you to print the Euler number. Euler number = (1 – the number of holes in a particle). The Euler number of a particle which has no hole is 1.
Moment M11:	Allows you to print the Moment M11. If the coordinates of the center of gravity of a particle are (wX, wY) and the coordinates of a pixel are (xj, yi), Moment M11 = SUM ((yi – wY) × (xj – wX)).
Moment M20:	Allows you to print the Moment M20. Moment M20 = SUM ((xj – wX) × (xj – wX)).
Moment M02:	Allows you to Prints the Moment M02. Moment M02 = SUM ((yi – wY) × (yi – wY)).
Angle:	Allows you to print the angle subtended between the X axis and the main axis (the direction in which the particle extends) in degrees (–90 ≤ angle ≤ 90).
ROI#:	Allows you to print information on the ROI to which each particle belongs. This function takes effect only when you select Multi ROI in the Binarize window.
Output Unit:	Allows you to specify the unit of the output value such as Auto, Pixel, mm, μm and pm. Auto automatically selects either mm, μm or pm. Pixel indicates the number of measurement points. Usually, μm should be selected.
Digit of Fraction Part:	Allows you to specify the number of digits after the decimal point of the output numerical value.

When you click on the "Apply" button shown in Fig. 7.12, the "Listing" window in which the results of measurement are printed will be displayed as shown in Fig. 7.13.



No.	Area [um^2]	Area % [%]	W(x, y) [mm]	Prmtr [um]	Cmpct	Max Lgth, W [um]	Fere W,H [um]
1	23.125	0.141	47.706, 69.648	18.907	0.813	7.215, 4.487	7.000, 3.75(
2	28.875	0.176	47.622, 69.649	20.260	0.884	7.521, 5.560	7.000, 4.50(
3	0.625	0.004	47.725, 69.657	2.061	1.850	1.031, 0.546	1.000, 0.50(
4	91.312	0.557	47.735, 69.676	56.024	0.366	19.849, 9.018	15.500, 15.0(
5	73.500	0.449	47.632, 69.677	44.524	0.466	13.686, 7.768	8.750, 13.5(
6	37.188	0.227	47.664, 69.681	22.667	0.910	7.198, 6.703	7.000, 6.75(
7	31.562	0.193	47.669, 69.685	21.314	0.873	7.040, 6.046	7.000, 6.00(
8	38.938	0.238	47.706, 69.689	22.314	0.983	7.198, 6.851	6.750, 7.00(
9	28.625	0.175	47.661, 69.689	20.046	0.895	6.619, 5.694	5.750, 6.50(
10	27.438	0.167	47.668, 69.693	18.753	0.980	6.250, 5.660	6.000, 5.75(
11	30.688	0.187	47.661, 69.697	20.460	0.921	6.576, 6.405	6.250, 6.50(
12	10.438	0.064	47.679, 69.701	16.864	0.461	7.754, 2.176	7.250, 2.75(
13	1.500	0.009	47.719, 69.713	4.828	0.809	2.236, 0.671	2.000, 1.25(
14	35.562	0.217	47.739, 69.736	32.185	0.431	12.415, 5.346	6.750, 11.2(
15	37.062	0.226	47.732, 69.734	23.081	0.874	7.649, 6.717	7.500, 6.75(
16	35.688	0.218	47.676, 69.741	21.753	0.948	6.973, 6.668	6.750, 6.50(
17	0.562	0.003	47.691, 69.739	1.707	0.965	0.791, 0.553	0.750, 0.50(
18	65.562	0.400	47.622, 69.744	42.274	0.461	13.786, 7.136	13.750, 6.75(
19	8.875	0.054	47.742, 69.744	12.493	0.715	5.000, 2.000	2.000, 5.00(
20	28.562	0.174	47.736, 69.745	19.814	0.914	6.619, 6.081	6.500, 6.00(
21	31.312	0.191	47.680, 69.747	21.107	0.883	6.619, 5.986	6.500, 6.00(

Fig. 7.13 “Listing” window

7.12 Save Stage

Select “Save Stage” from the “Particle” pull-down menu, and the “Save stage for Point analysis” window will be displayed as shown in Fig. 7.14.
If you have selected “Save stage,” you can save the center of gravity of a particle in a point-analysis coordinate file. If you want to save all the coordinates, select the “All” button. If you want to save some of the coordinates, select the “Partial” button and enter the number of coordinate pairs to be saved using the keyboard. If you deselect the “Save stage” button, you cannot save the coordinates.

“Sort by” enables you to specify the order of saving. When you select “Area value,” you can save the coordinates in the order of area. When you select “Compactness,” you can save the coordinates in the order of compactness. “Sort order” enables you to specify the order of selection. When you have selected “Area value,” you can save the coordinates in sequence, from the largest number downward by clicking on the “Top” button, or from the smallest number upward by clicking on the “Bottom” button. Selecting the “Middle” button enables you to save the coordinates, both upward and downward, in sequence from the median value of area. When you select “Compactness,” on the other hand, since a particle with the best compactness is 1, you can save the coordinates in sequence, from the number closest to 1 by clicking on the “Top” button, or from the number closest to 0 by clicking on the “Bottom” button. Selecting the “Middle” button sorts the coordinates in sequence from 1 and saves them from the median value.

In the “Omit border” selection boxes you can exclude the particles existing around the image from the object to be saved. If you want to put some restriction on the size or compactness of the particle to be saved, select “Area value Thres.” or “Compactness Thres.” and specify the minimum and maximum values in the “Min” and “Max” input boxes. Only the particles that exist within the range specified here can be saved.

Let’s take Fig. 7.14 as an example. Clicking on the “Apply” button causes the system to save the stage positions of up to 20 particles, and only those particles included in the particle area between the minimum and maximum values can be saved.

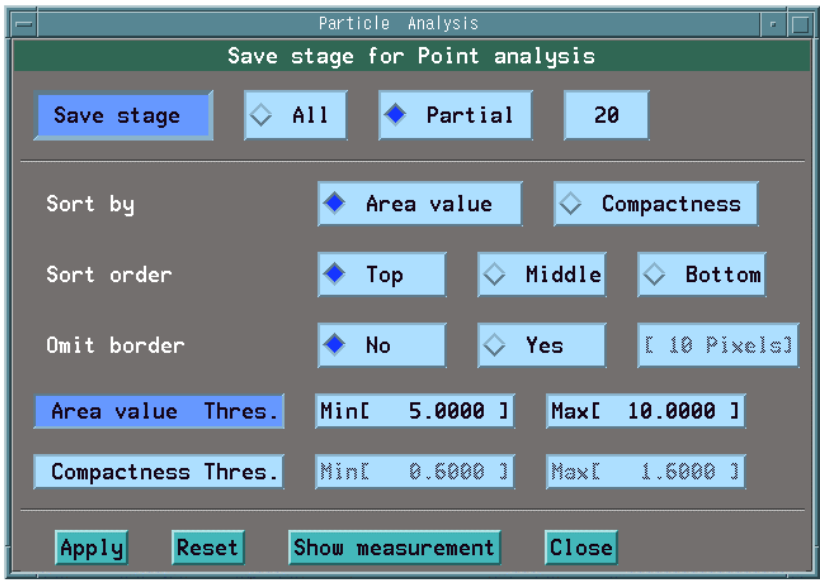


Fig. 7.14 “Save stage for Point analysis” window

7.13 Display

Select “Display” from the “Particle” pull-down menu and the “Display of Labeled Data” window will be opened as shown in Fig. 7.15.
This window enables you to display the results of particle analysis superposed on a labeled image.

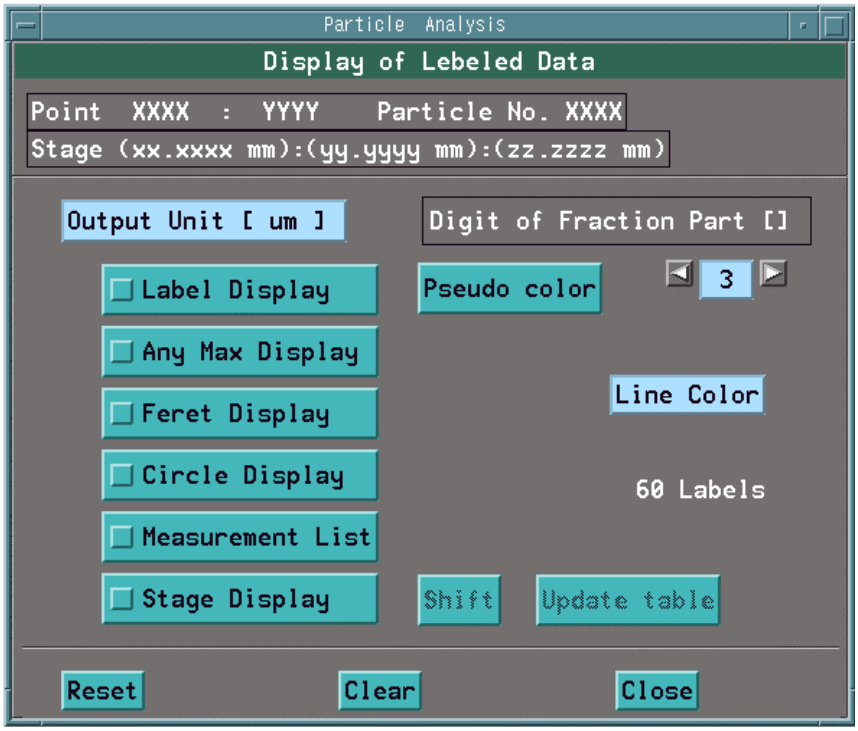


Fig. 7.15 “Display of Labeled Data” window

Output Unit:	You can specify the unit of output numerical values such as Pixel, mm, μm and pm. Auto automatically selects either mm, μm or pm. Pixel indicates the measurement points. Usually, μm should be selected.
Digit of Fraction Part:	Enables you to specify the number of digits after the decimal point of the output numerical value.
Pseudo color:	This is a toggle button used to select whether to display an image in pseudo color or in gray scale.
Line Color:	You can specify the color of the line to be drawn.

If you click on one of the following buttons, you can display measurement results superposed on particles.

Label Display:	Allows you to superpose label numbers on particles.
Any Max Display:	Allows you to superpose the maximum angular distance on particles. Selecting this button once again also displays, as a numerical value, the length of the maximum angular distance simultaneouly superposed on particles.
Feret Display:	Allows you to draw rectangles that enclose the circumferance of a particle(s).

Circle Display:	Allows you to draw a circle with area equal to the area of a particle.
Measurement List:	Allows you to open a text window on which to display particle analysis results.
Stage Display:	Allows you to display the saved stage positions superposed on particles.
Shift:	Used to correct the stage positions. When “Stage Display” has been selected, select “Shift” and drag the mouse over the coordinates of the image to correct the coordinates.
Update table:	Used to update the coordinates corrected with the “Shift” function, and save them in a file.

Fig. 7.16 shows an example of label numbers superposed on particles. Fig. 7.17 shows an example of the maximum angular distance superposed on particles. Fig. 7.18 shows an example of Feret’s diameters. Fig. 7.19 shows an example of Heywood diameter. Fig. 7.20 shows an example of stage positions. These parameters are not stored in the computer memory as the commands for fully automatic particle analysis.

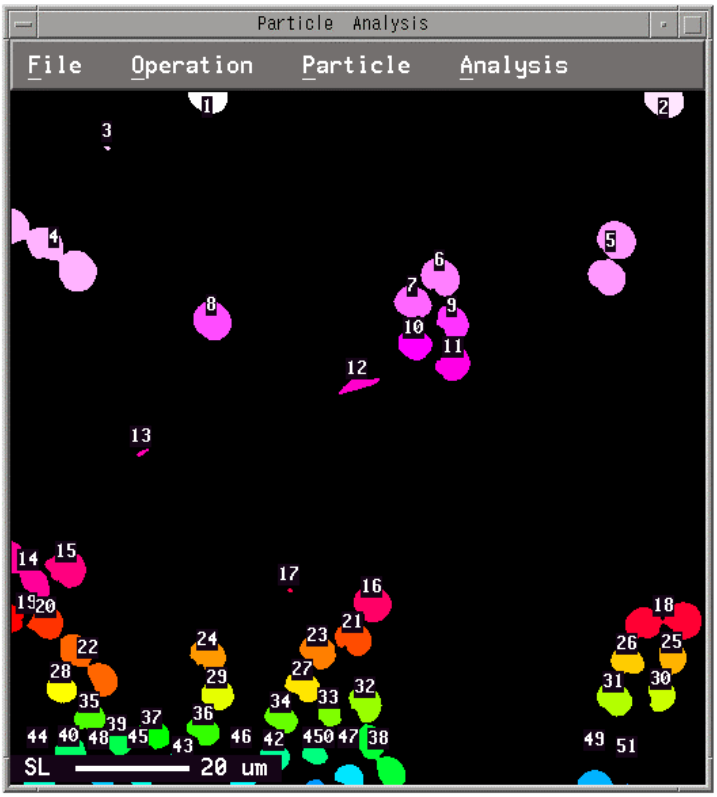


Fig. 7.16 Label numbers

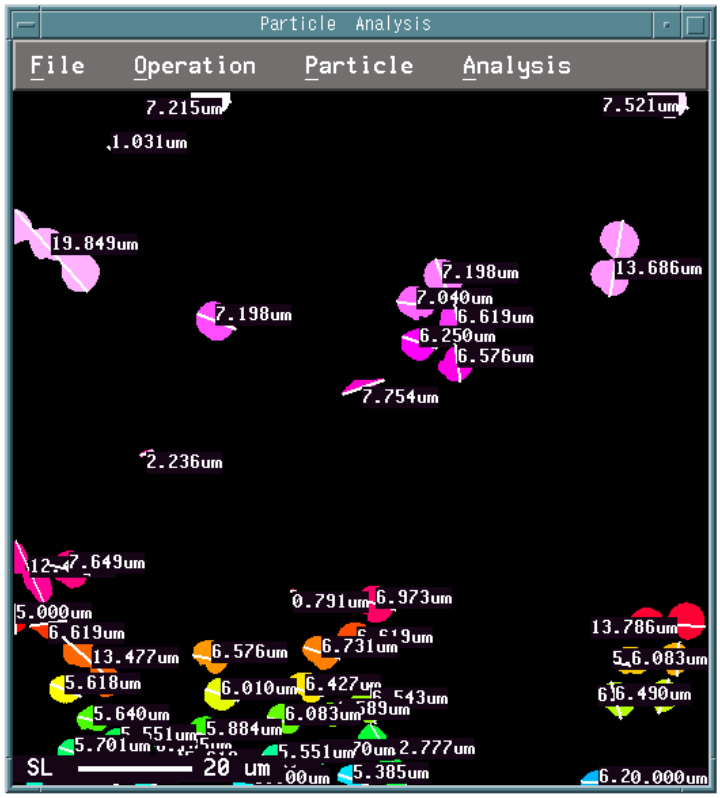


Fig. 7.17 Maximum angular distance

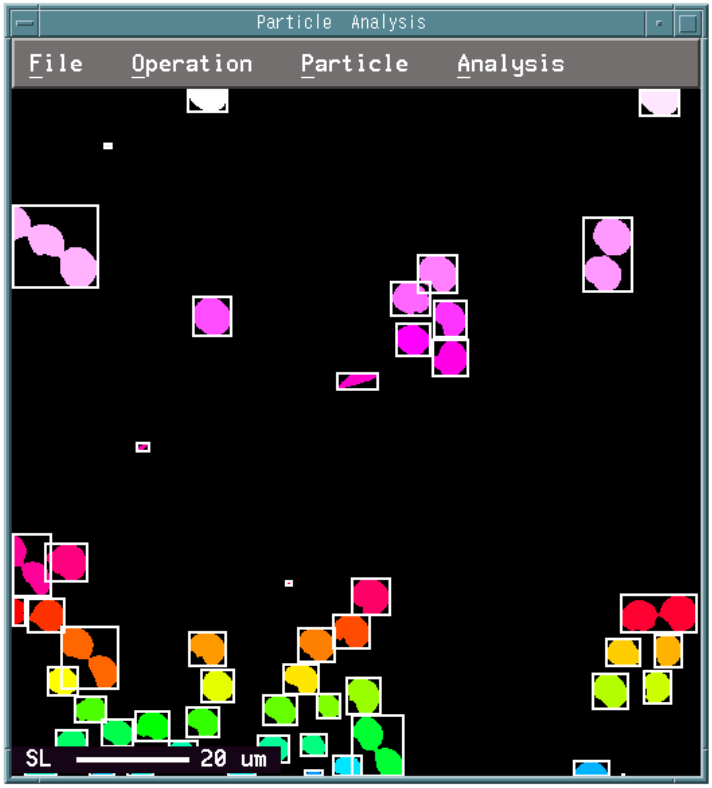


Fig. 7.18 Feret's diameters

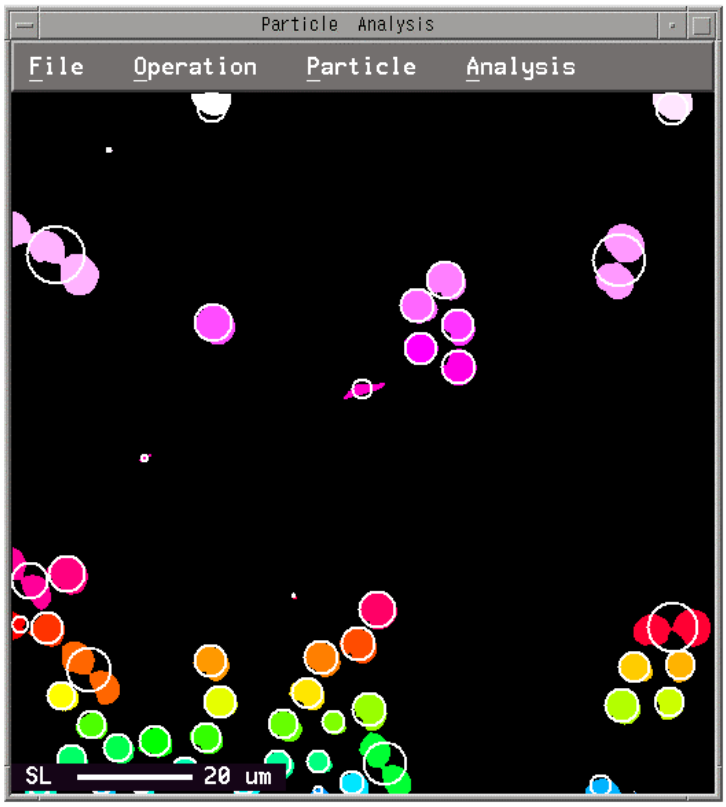
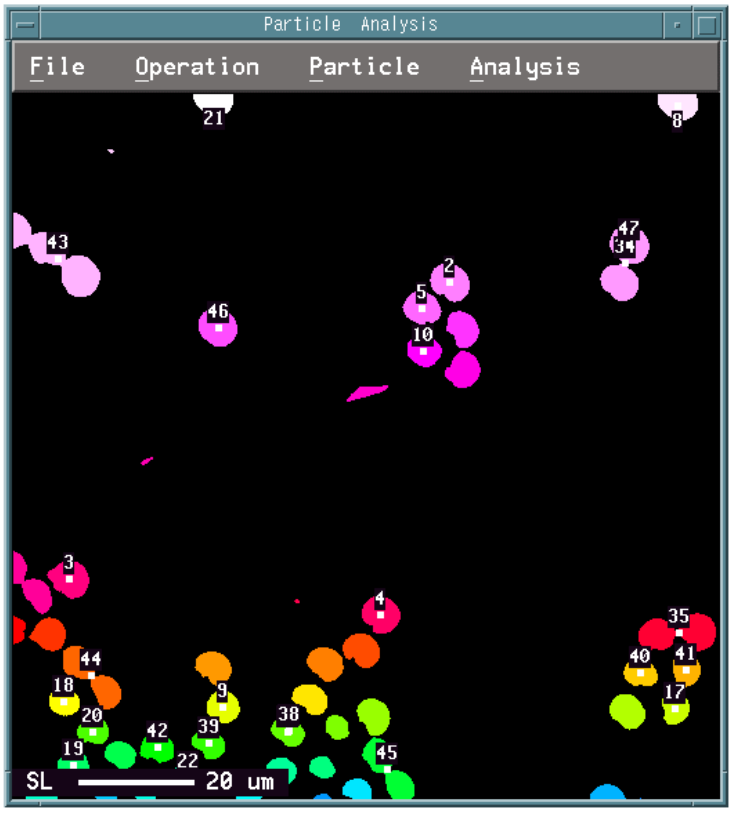


Fig. 7.19 Heywood diameter



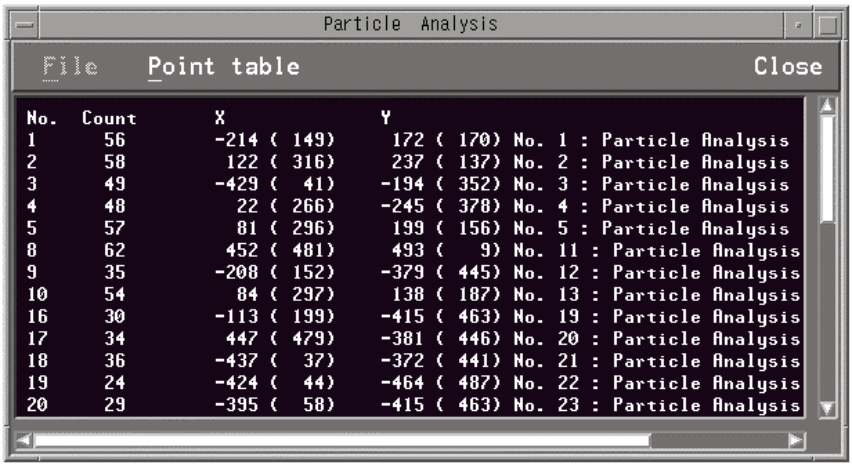


Fig. 7.20 Stage positions

7.14 Histogram

Select “Histogram” from the “Particle” pull-down menu, and the “Histogram of Labeled Data” window will be displayed as shown in Fig. 7.21.

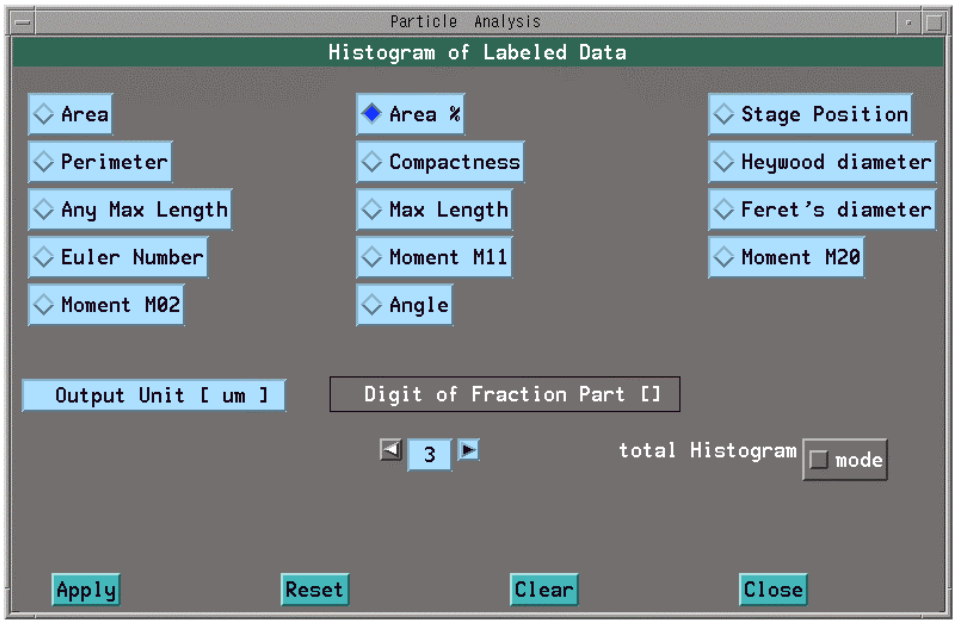


Fig. 7.21 “Histogram of Labeled Data” window.

Select one of the following functions:

Area:	Histogram of the areas of the particles
Area %:	Histogram showing the percentages of the areas of the particles against all the pixels
Stage Position:	Histogram of the stage positions
Perimeter:	Histogram of the perimeters
Compactness:	Histogram of the compactnesses
Heywood diameter:	Histogram of the Heywood diameters
Any Max Length:	Histogram of the maximum lengths in any arbitrary direction
Max Length:	Histogram of the maximum lengths of x and y
Feret’s diameter:	Histogram of the Feret’s diameters of x and y
Euler Number:	Histogram of the Euler Numbers
Moment M11:	Histogram of the moments M11
Moment M20:	Histogram of the moments M20
Moment M02:	Histogram of the moments M02
Angle:	Histogram of the angles (degrees) against the main axis
Output Unit:	You can specify the unit of the output numerical value. The output units are Pixel, mm, µm and pm. Auto automatically selects either mm, µm or pm. Usually, µm should be selected. Pixel indicates the measurement points.
Digit of Fraction Part:	Enables you to specify the number of digits after the decimal point of the output numerical value.

Cumulative freq.: If this button is off, the vertical axis of the histogram shows the frequency of appearance. If it is on, the vertical axis shows the cumulative frequency of the histogram.

By clicking on the “Apply” button in Fig. 7.21, you can obtain the histogram as shown in Fig. 7.22.

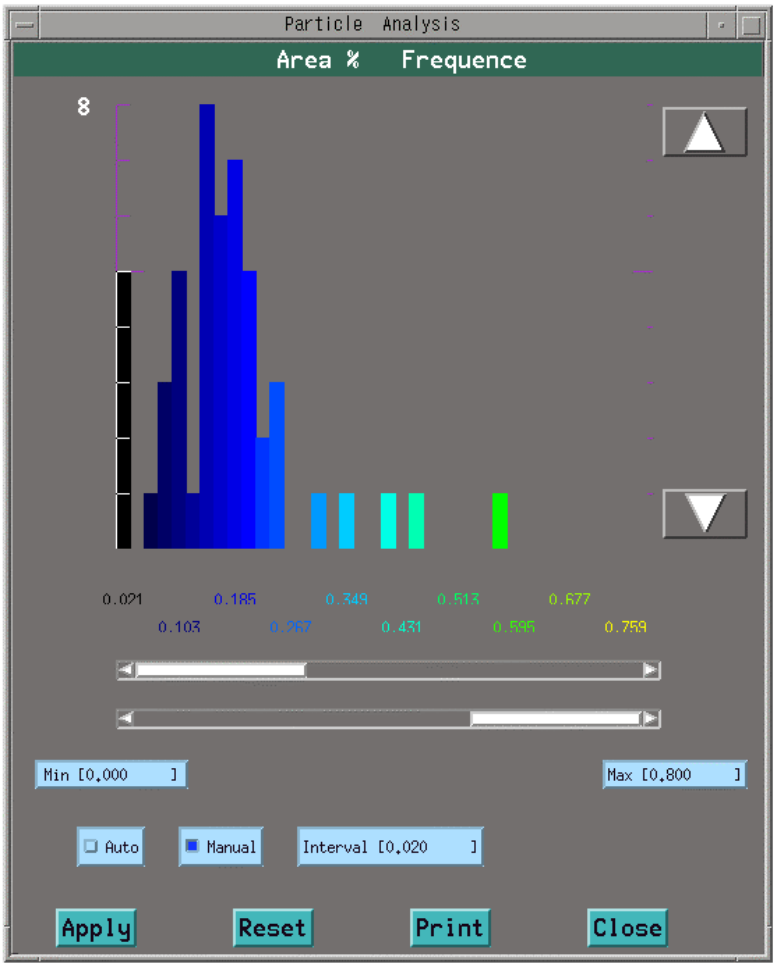


Fig. 7.22 An example of an “Area % Frequency” histogram

The histogram that appears when you select “Auto” in Fig. 7.22 displays the frequency of appearance obtained when the “Min” and “Max” value sections are equally divided into the number of colors and the interval size is displayed in the “Interval” button. If you select “Manual,” you can specify the interval size using the “Interval” button. In this case, an appropriate “Max” value is determined in the vicinity of the previous “Max” value from the “Min” value and the “Interval” value. When you input the “Max” value, you obtain a histogram in which the “Min” and the “Max” value sections are equally divided by the “Interval” value. In the displayed histogram, the labeled particle images are colored according to the histogram colors, thus enabling you to recognize the sizes of particles by color.

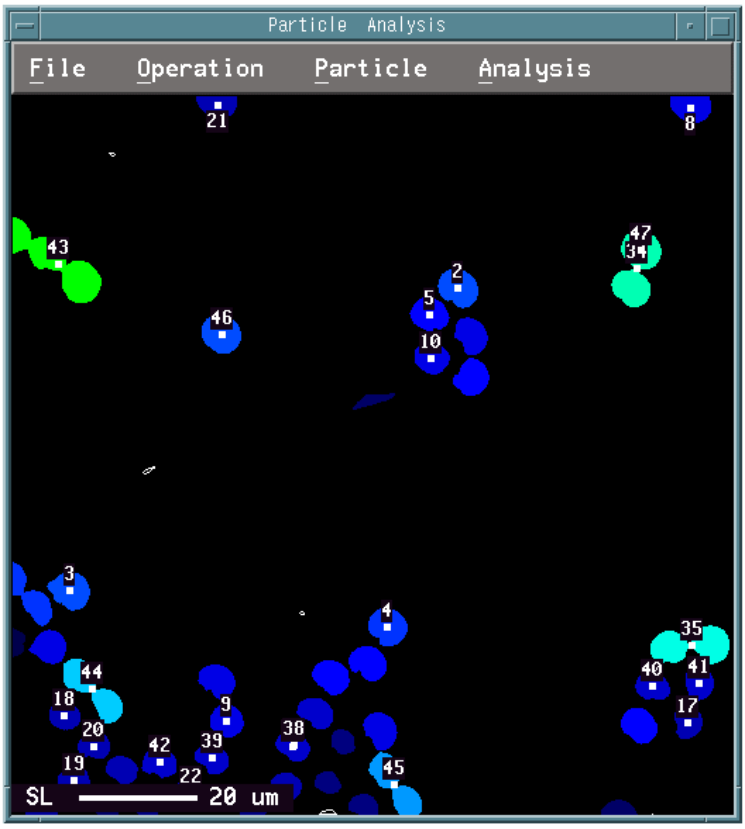


Fig. 7.23 Labeled images when an “Area” histogram is selected

8 ANALYSIS MENU

Click on the “Analysis” on the menu bar in Fig. 4.1, and the “Analysis” pull-down menu will be displayed as shown in Fig. 8.1.

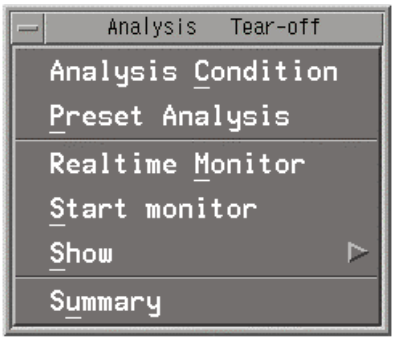


Fig. 8.1 “Analysis” pull-down menu

8.1 Analysis Condition Input Window

Select the “Analysis Condition” button from the pull-down menu, and the “Particle Analysis” window will be displayed as shown in Fig. 8.2.
You can set analysis conditions for fully automatic particle analysis in this window.

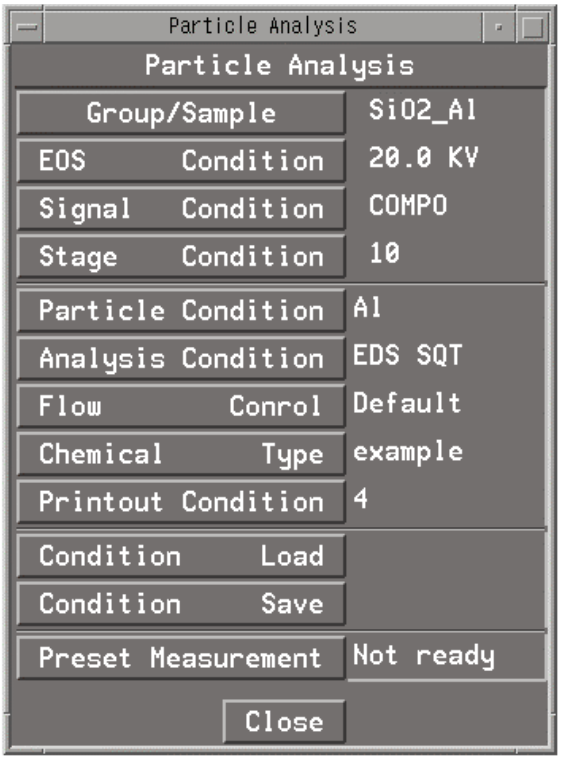


Fig. 8.2 “Particle Analysis Condition Input” window

8.1.1 Group/Sample

You can select or create group names and sample names. You can record multiple sample names under one group name.

You can select sample names, record new sample names, delete sample names, change recorded names and print results by operating the buttons in the “Select Sample” window. Also, you can rearrange the sample names recorded in the list in alphabetical order or in the order of recorded dates by selecting “Name” or “Date” in the “Sorting Order” selection box. When changing the Group name, click on the Group button to display the Group window where you can select the desired Group name or record a new Group name.

The functions of the buttons located at the bottom of the window are as follows.

“New” button:	Allows you to record a new sample name. You can use up to 14 alphanumeric characters for a smple name.
“Rename” button:	Allows you to change sample names.
“Delete” button:	Allows you to delete sample names. Please note that data following sample names are also deleted.
“Print” button:	Allows you to print a list of sample names on a printer.

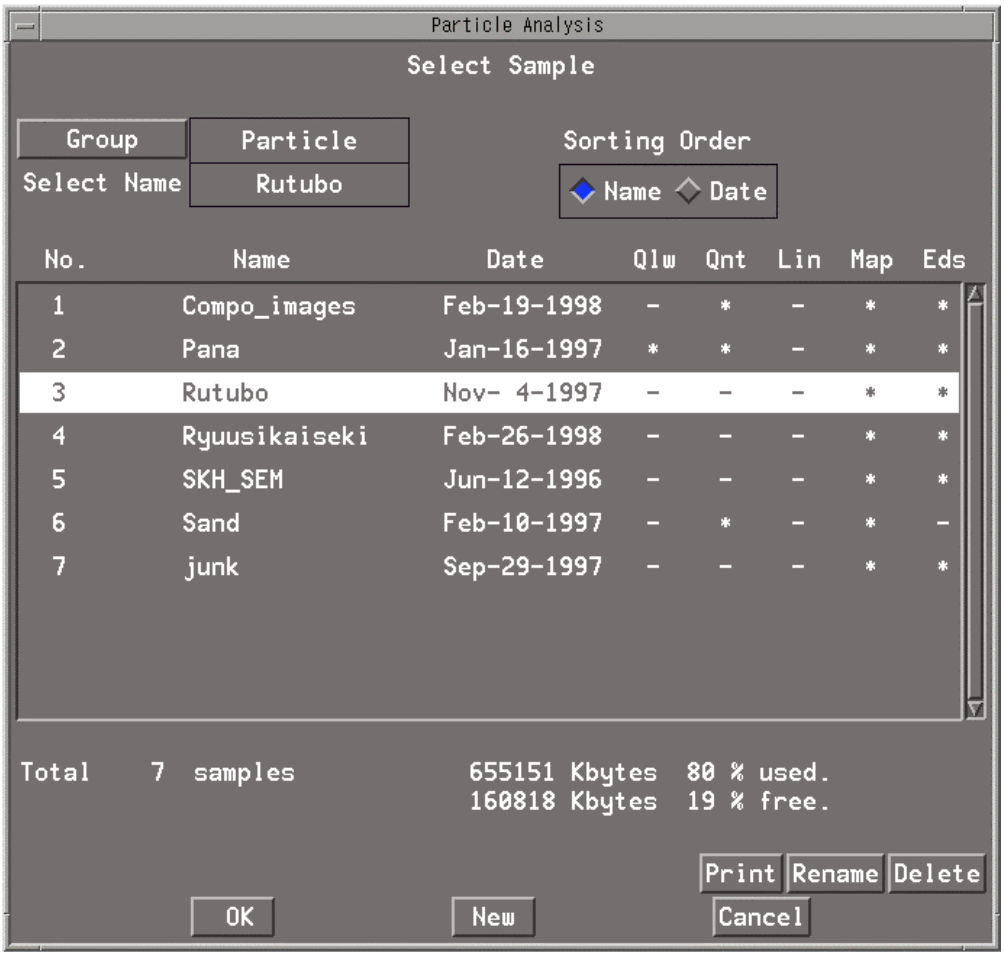


Fig. 8.3 “Select Sample” window

8.1.2 EOS Condition

Click on the “EOS Condition” button in the “Particle Analysis Condition Input” window, and the “EOS Condition” window will be displayed as shown in Fig. 8.4.
You can set the EOS (electron optics system) conditions in this window. When you open the “EOS Condition” window, the EOS conditions that were previously set will appear. To change any of the set conditions, click on the item to be changed and enter a new numeric value into the input box using the keyboard.

Click on the “Set” button and the EOS conditions will be set. If you click on the “Read” button, the active EOS conditions will be read and displayed in the window. To set the current for measurement, first, select “Auto” and then, enter the current you want to set into the “Auto” input box using the keyboard. In this case, the CL (condenser lens) value is controlled so that the current becomes the specified value before the particle measurement is started. If you click on the “OK” button, the active EOS conditions will be recorded in a file. If you click on the “Cancel” button, the set values will be erased.

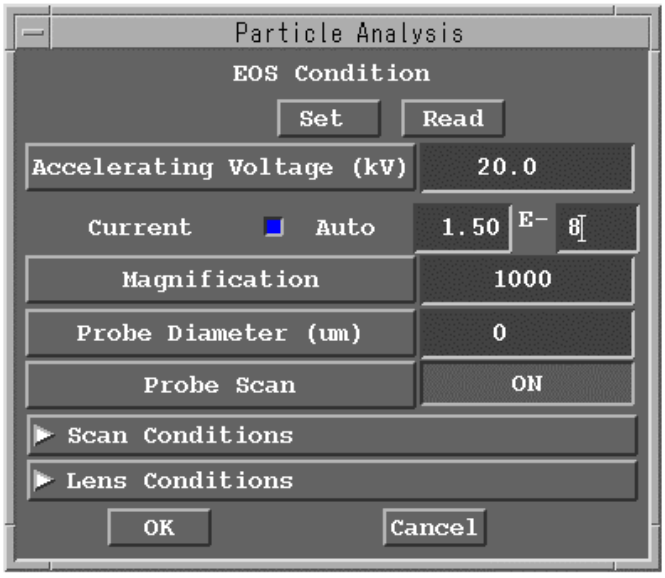


Fig. 8.4 “EOS Condition” window

8.1.3 Signal Condition

Click on the “Signal Condition” button in the “Particle Analysis Condition Input” window, and the “Signal Condition” window will be displayed as shown in Fig. 8.5.
You can specify the kind of image signal in this window. When the image signal is a backscattered electron image (COMPO), you can perform the calibration to obtain the mean atomic number by clicking on the “Calibration” button.

Signal: You can select an image signal. Select one of the following image signals.

- SEI (SL): Secondary electron image
- COMPO (CP): Backscattered electron image
- TOPO (TP): Topography image
- AUX (AX): Auxiliary signal

Signal Accum.: You can specify the number of images to accumulate. The maximum number that you can specify here is 32. The maximum signal value obtained when accumulation is performed once is 2040. When accumulation is performed 32 times, the maximum value is 32 × 2040, or 65280.

Cont./Brigh.: You can adjust the contrast and brightness of an image. To read in the active contrast and brightness of an SEI image, click on the “Read” button located at the bottom of the window.

Get ISD: An image signal is acquired. You can check if the contrast/brightness conditions are correct.

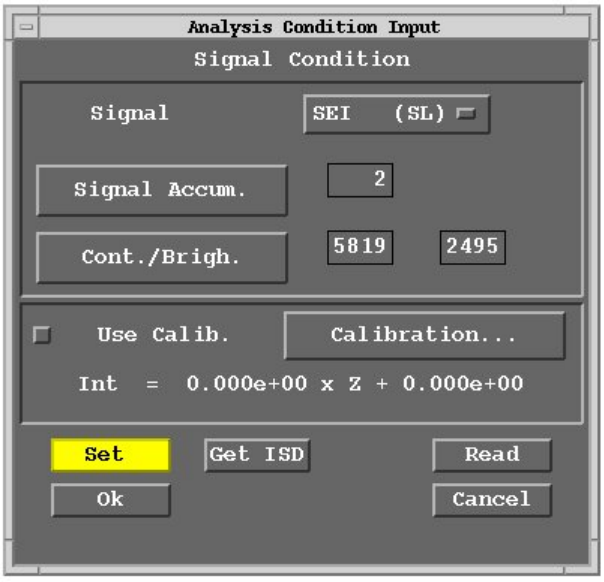


Fig. 8.5 “Signal Condition” window

If the signal is a backscattered electron image, you must carry out the calibration in order to use the mean atomic number to determine the binarization threshold levels.

“Use Calib.” button: This button must be pressed when you use a calibration value. The active calibration-curve factor is indicated under this button.

"Calibration . . ." button: If you click on the "Calibration . . ." button, the "Calibration Condition" window will be displayed as shown in Fig. 8.6.

Set two standard samples having different mean atomic numbers in this "Calibration Condition" window shown in Fig. 8.6.

Elem: Allows you to enter an arbitrary standard-sample name. If it is a simple element name, the mean atomic number is automatically calculated and displayed.

Z: Allows you to enter the mean atomic number.
The calculation formula is
Z = Sum (concentration × atomic number).
Note that the concentration is the value such that Sum (concentration) = 1.

X, Y, Z [mm]: Allows you to enter the stage position of the standard sample. The default is the coordinates that are recorded in the stage monitor.

Read: Allows you to read the active stage position as the stage position of the standard sample.

Int.: Allows you to indicate the intensity during calibration in μA.

Raw Int.: Allows you to indicate the raw intensity during calibration.

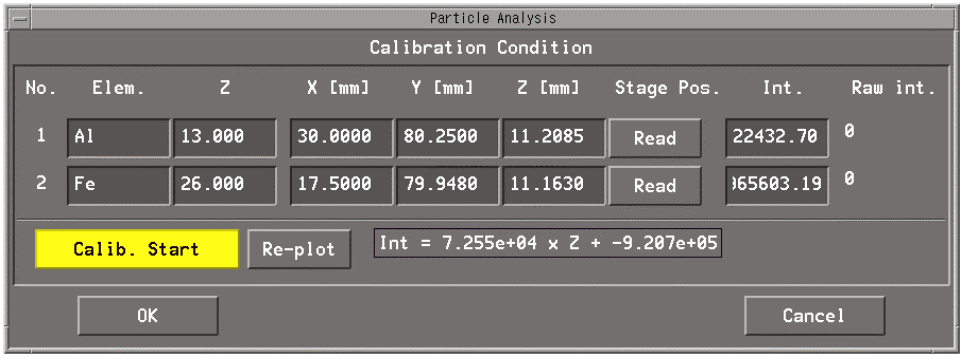


Fig. 8.6 "Calibration Condition" window

Clicking on the "Calib. Start" button starts the calibration. To carry out the calibration, first, the PCD (probe current detector) is closed and the sample current is read, then the PCD is opened and the stage is moved to the first standard-sample position; then the backscattered electron intensity is measured. Next, the stage is moved to the second standard-sample position; then the backscattered electron intensity is measured in the same way. A and B coefficients can be obtained from the mean atomic numbers and the intensities of the two standard samples, and a straight line is displayed on the graph as shown in Fig. 8.7. Note that coefficients A and B are normalized in μA. If you click on the "Re-plot " button, the straight line that was previously measured is displayed.

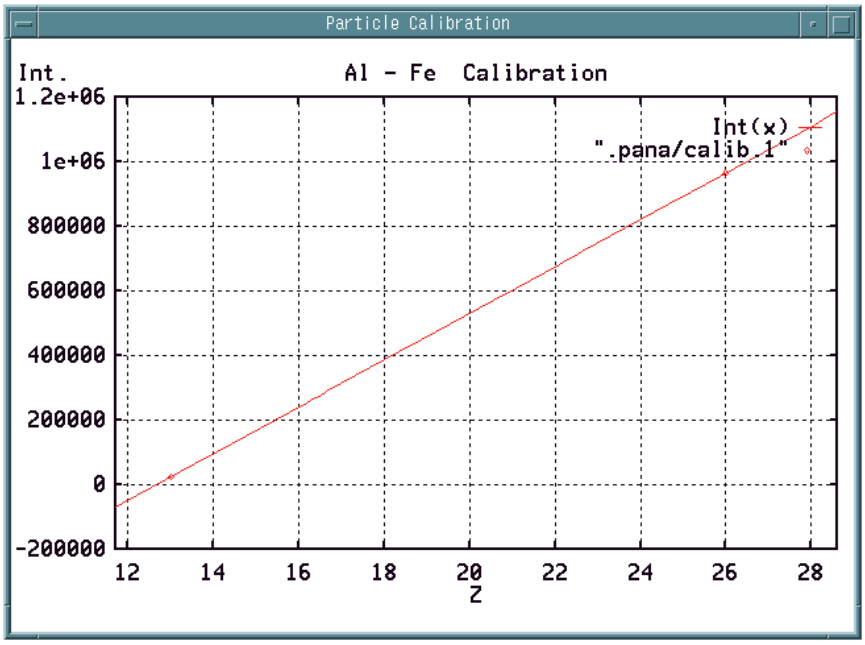


Fig. 8.7 An example of "Calibration Curve"

8.1.4 Stage Condition

Click on the "Stage Condition" button in the "Particle Analysis Condition Input" window, and the "Stage Condition" window will be displayed as shown in Fig. 8.8.
If the analysis region has already been recorded under the active sample name, the recorded analysis region will be displayed. In this window you can set the analysis region (the "Particle" button in the window), correct it by clicking on the "Pos. input" button or delete it by clicking on the "Clear" button.

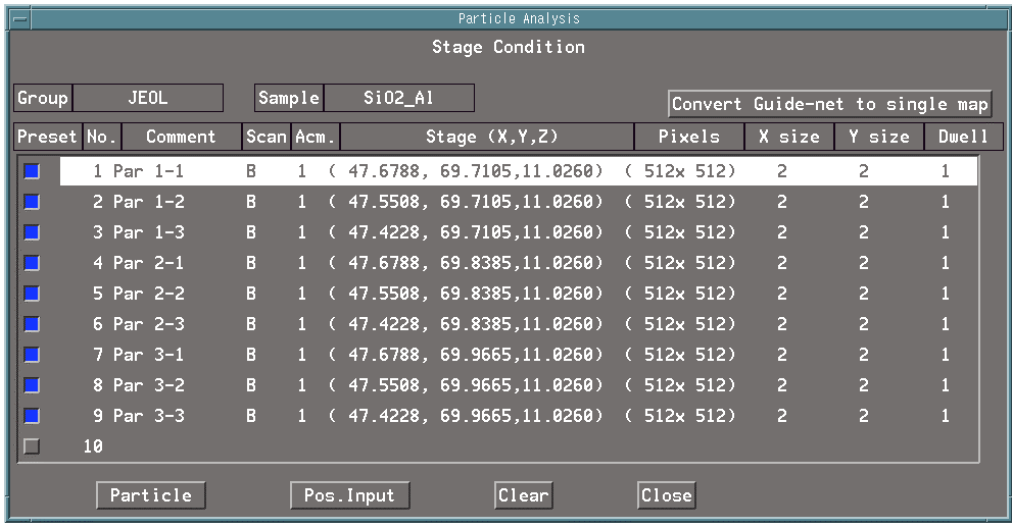


Fig. 8.8 "Stage Condition" window

■ Analysis area

Click on the “Particle” button in the “Stage Condition” window shown in Fig. 8.8, and the “Image Condition Input” window will be displayed as shown in Fig. 8.9.
Shown in Fig. 8.10 is the sequence for measuring an image in particle analysis. The image measurement in particle analysis is automatically performed sequentially in the numbered areas, and particle analysis is performed in each image. The scan method you can specify in this window is beam scanning. The movement from one analysis area to another is done by moving the stage. Fig. 8.10 shows the analysis areas appearing when acquisition of 3 × 3 images is specified.

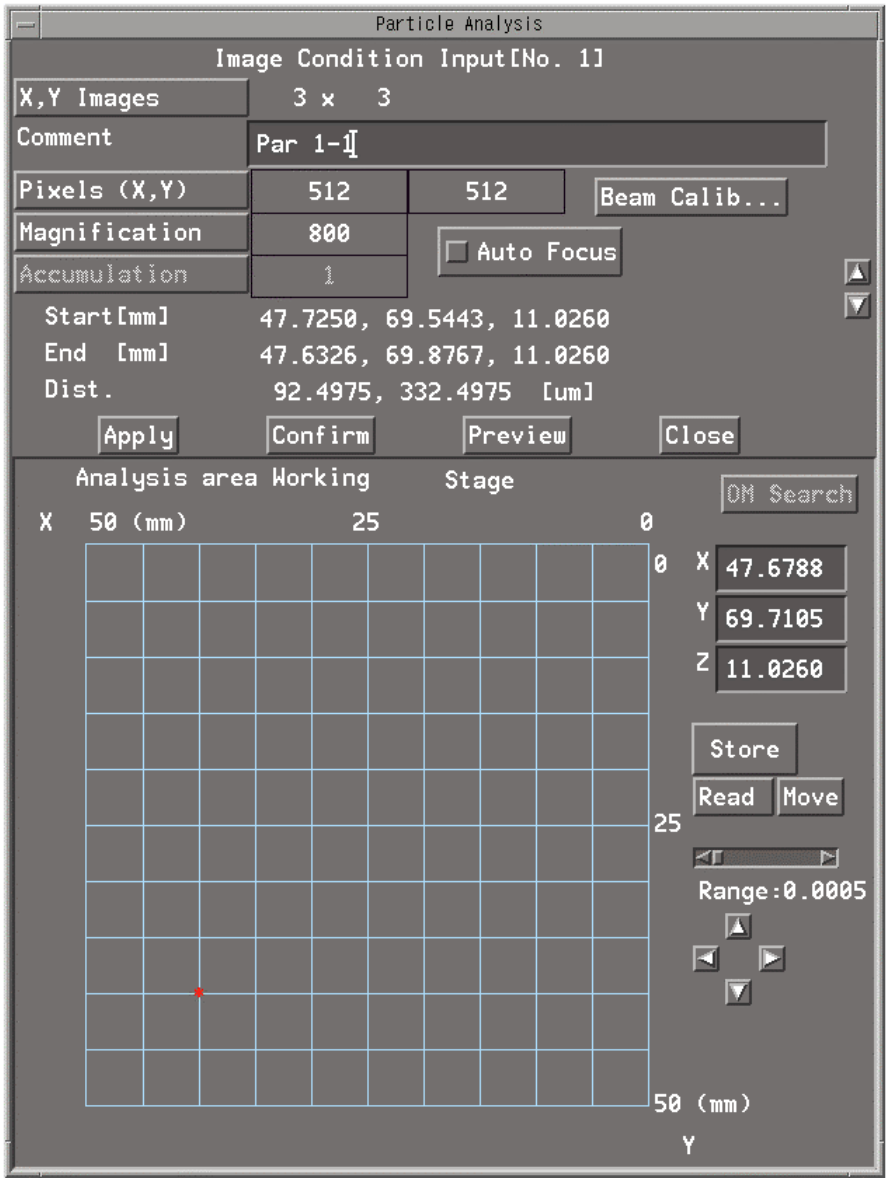


Fig. 8.9 “Image Condition Input” window

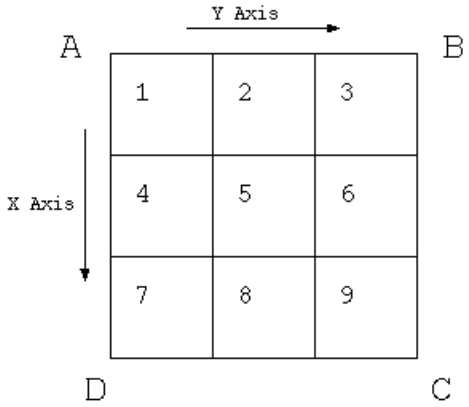


Fig. 8.10 A schematic of image measurement in particle analysis

The functions of the buttons in the " Image Condition Input" window are as follows.

X, Y Images:	Allows you to specify the number of images to be acquired in the X and Y directions. The maximum number of images you can specify is 10,000 in total.
Comment:	Allows you to input a comment. A maximum of 40 letters can be input. The key words "Par xx-yy" are automatically displayed before the comments you input. Here, xx and yy are the numbers of lines in the X and Y directions.
Pixels:	Allows you to specify the number of pixels in the X and Y directions. The minimum number of pixels you can specify is 128 and the maximum number is 1024. You can input any arbitrary integer from 128 to 1024, but in order to obtain accurate particle diameters you should select 128, 256, 512 or 1024.
Magnification:	Allows you to specify the scanning magnification of the EOS system to be applied when you acquire images using the beam scan. The scan area per image is determined by this magnification. The minimum magnification you can specify is 40 times and the maximum magnification is 300,000 times. Magnification setting is also available in the EOS conditions, but the magnification you specify in this "Magnification" input box is used to acquire images.
Accumulation:	The number of images to accumulate, which was specified in the "Signal Accum." input box in the "Signal Condition" window shown in Fig. 8.5., is displayed here.
Beam Calib . . .:	Allows you to obtain the correction factor of the EOS operation magnification and the stage position. For the detains of the calibration, refer to the next subsection.
Start, End:	Allows you to indicate the measurement starting and ending points of the entire analysis area calculated from the above conditions.

Dist.:	Allows you to indicate the lengths along the X and Y axes of an image calculated from the above conditions.
Analysis area Working:	Allows you to input the analysis points in this two-dimensional region. The measurement range is indicated in the two-dimensional display area in which there are “Analysis area Working” lattices. A rectangular frame and ‘x’ are indicated inside the display area. The coordinates of the ‘x’ position are indicated on the right-hand side of the two-dimensional display region.

■ Specifying the Analysis Region

Set the analysis region in accordance with the setting of the scan range in the mapping analysis program.

☞ For the setting details, refer to the instruction manual “Mapping Analysis Program,” Sect. 4.2.4a “Specifying Analysis Position.”

The analysis area in particle analysis is a rectangle as shown in Fig 8.10. Point A is the starting point of analysis and point C is the ending point. The following is an example of inputs that are considered to be standard inputs.

- Determine the scanning magnification in accordance with the size of particles you want to find. For example, when you observe an image with scanning magnification 500 times and 512 pixels, the overall field of view is about 0.2 mm, and the length of 1 pixel corresponds to about 0.4 μm. Therefore, if there is a particle that is 1 μm long or so, its length will be about two pixels.
- Search for all the areas you want to measure using a secondary electron image, a backscattered electron image or an OM (optical microscope) image.
- Then, move the stage to the starting point, the ending point or the center of the analysis area, and read the present position of the stage with the “Read” button.
- Next, click on the “Store” button and select “Store to start,” “end” or “center” in accordance with the read position.
- Click on the “Preview” button to check the overall analysis area. If the overall analysis area is not the desired area, repeat the third and fourth steps above. If the overall analysis area is not a square, you might have to correct the x and y maps.
- When the overall analysis area has been determined, move the stage to the four corners of the analysis area using the “Preview” button and adjust the Z focus with the joystick. The value of the Z axis of each analysis area where the beam scan is to be performed is calculated from the value of the Z axis of point A, point B, point C and point D in the four corners. If you want to confirm the Z axis of each scan area, click on the “Confirm” button.

When you have finished all the above operations, click on the “Apply” button and the conditions will be established and the scan conditions will be set to the scan-condition setting columns in the “Stage Condition” window shown in Fig. 8.8.

■ Correcting the scanning magnification and the stage position

Click on the “Beam Calib. . .” button in the “Image Condition Input” window shown in Fig. 8.9, and the “Beam Image Calibration” window will be displayed as shown in Fig. 8.11.

You can obtain the correction factor of the scanning magnification and the stage position by carrying out the calibration in this window. The correction factor is recorded in the file /opt/epma/cali/eos/sgsp.cnd for each scanning magnification. The following is the procedure for carrying out the calibration.

- Set the scanning magnification and look for a point that can be a mark while watching an actual image.
- Click on the “Start Calib…” button.
- A cross marker will be displayed on the top left corner of the first observation CRT. Move the mark under the cross using the joystick. When the stage position has been determined, press the “Store” button. Please note that you should use SLOW1 or SLOW2 as the scan speed.
- The cross on the first observation CRT moves to the bottom right corner. Move the same mark as used in the third step above under the cross in the bottom right corner. When the stage position has been determined, press the “Store” button.
- The calibration values in the X and Y axes will be calculated and the values in the X and Y axes will be updated.

If you click on the “OK” button, the calibration values will be set. If you click on the “Cancel” button, the values will not be set.

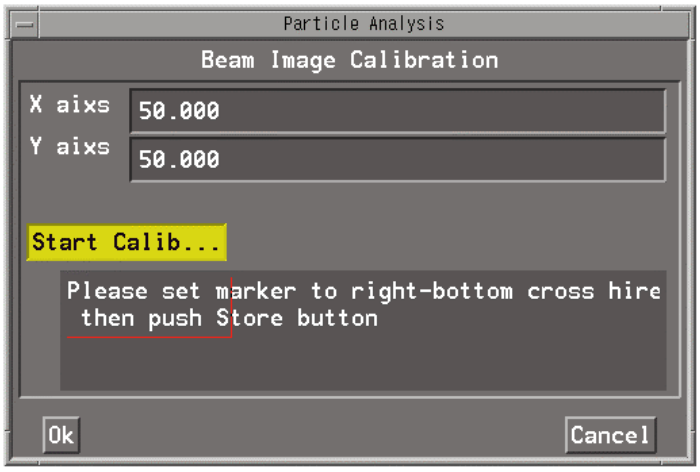


Fig. 8.11 “Beam Image Calibration” window

8.1.5 Particle Condition

Click on the “Particle Condition” button in the “Particle Analysis Condition Input” window, and the “Particle analysis condition load” window will be displayed as shown in Fig. 8.12.

You can specify the conditions for particle analysis in this window.

If you select “From Present Condition File,” you can use the present conditions for particle analysis. If you select “From Stored Condition File,” you can select the list of the stored conditions for particle analysis. So, select one condition from the list. When you click on the “Check” button, the “Auto” window will be displayed as shown in Fig. 7.2.

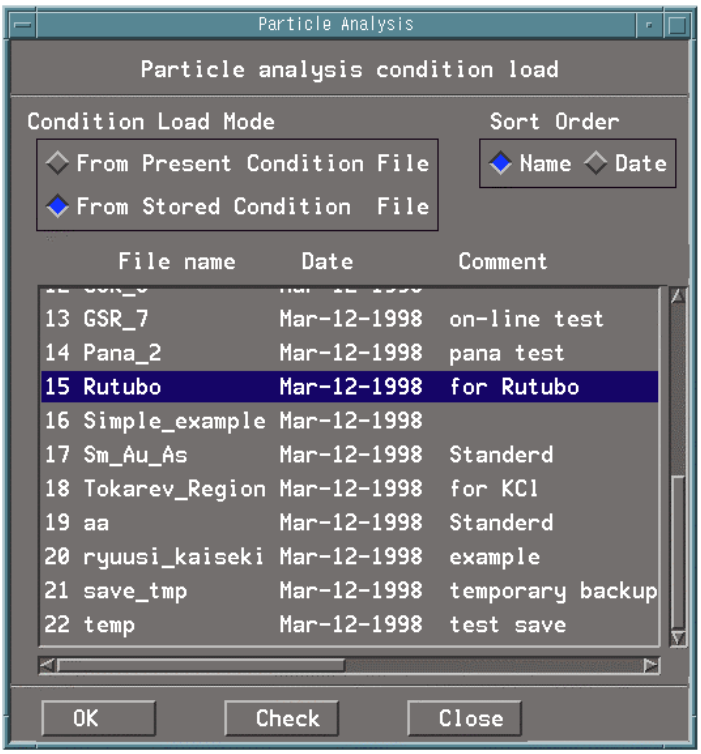


Fig. 8.12 "Particle analysis condition load" window

8.1.6 Analysis Condition

Click on the "Analysis Condition" button in the "Particle Analysis Condition Input" window, and the "Measurement Condition" window will be displayed as shown in Fig. 8.13.

In this window you can set the conditions for point analysis to be performed on the particles determined by fully automatic particle analysis.

Measurement:	Allows you to specify execution or non-execution of the measurement for point analysis.
Yes:	Allows you to execute the measurement for point analysis.
No:	Does not allow you to execute the measurement for point analysis. In this case, point analysis is omitted and only particle analysis is executed.
Measurement Kind:	Allows you to specify the kind of point analysis. You can select qualitative analysis, semi-quantitative analysis or quantitative analysis by EDS and WDS.
EDS Analysis:	EDS qualitative analysis. The measurement conditions can be changed by clicking on the "Condition Change…" button.
EDS Semi-Quant.:	EDS semi-quantitative analysis. The measurement conditions can be changed by clicking on the "Condition Change…" button.

WDS Analysis: WDS qualitative analysis. The scan condition must be set in advance in the main window for qualitative analysis.

WDS Semi-Quant.: WDS semi-quantitative analysis. The scan condition must be set in advance in the main window for qualitative analysis. The measurement conditions can be changed by clicking on the “Condition Change…” button.

ED/WD Quantitative: ED/WD combined quantitative analysis. The measurement conditions must be set in advance in the main window for quantitative analysis.

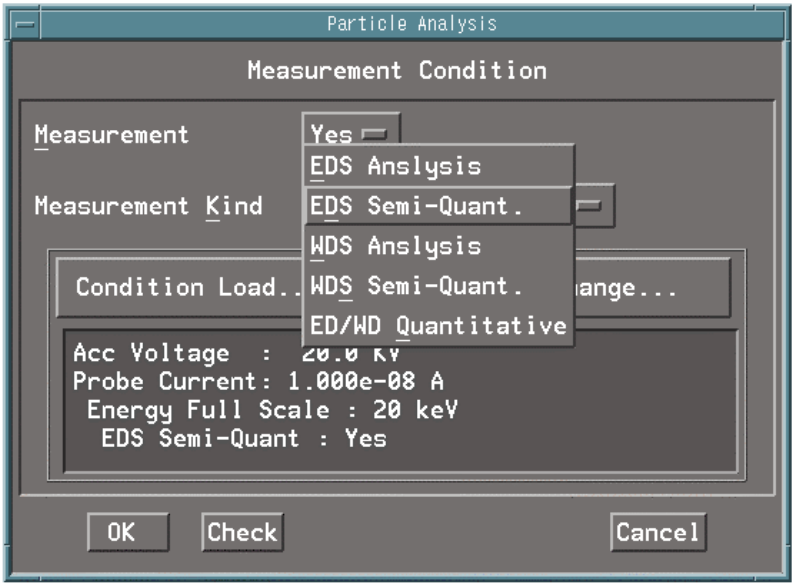


Fig. 8.13 “Measurement Condition” window

Condition Load: Allows you to read the recorded conditions for the measurement selected by the “Measurement Kind” button. You can select the active measurement conditions or read the conditions that are stored in advance.

From Present Condition Files: Allows you to use the active conditions that are being used now.

From Stored Condition Files: Allows you to use the stored conditions.

If you click on the “OK” button, the conditions will be determined and the window will be closed. If you click on the “Check” button, the active conditions will be displayed. If you click on the “Cancel” button, the settings will be canceled.

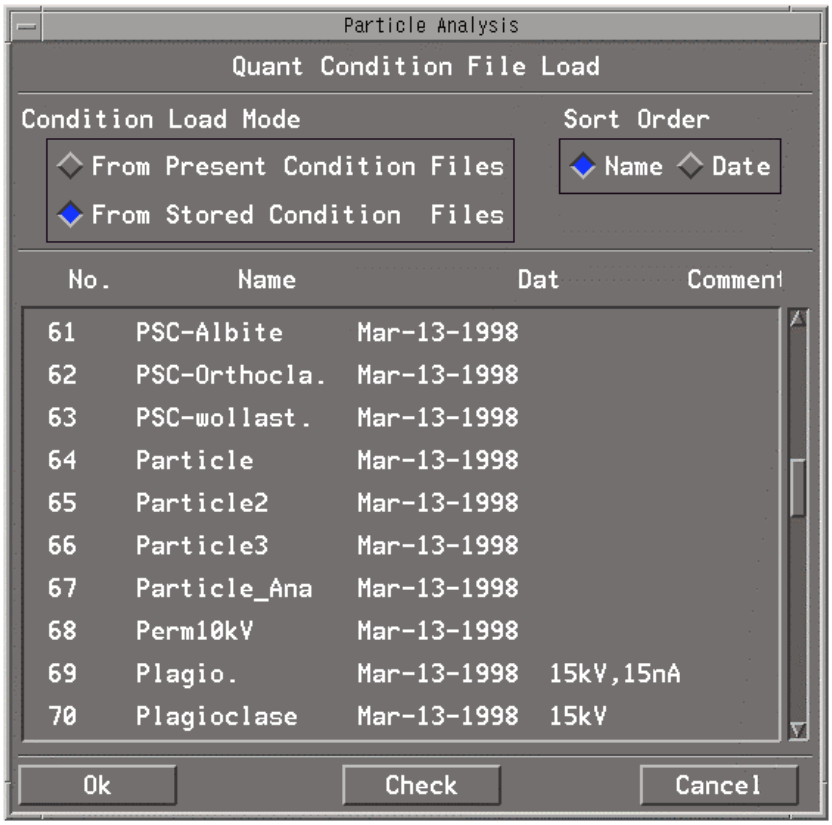


Fig. 8.14 “Quant Condition File Load” window

Condition Change…: Clicking on the “Condition Change…” button in the “Measurement Condition” window shown in Fig. 8.13 will display the “Change Measurement Conditions” window as shown in Fig. 8.15. You can change the following measurement conditions, depending upon the measurement kind.

EDS Analysis/EDS Semi-Quant:
EDS qualitative analysis, EDS semi-quantitative analysis

- EOS Condition: Electron optics system conditions
- EDS Condition: EDS analysis conditions
- Semi-Quant.: On-line semi-quantitative analysis conditions (used only when EDS semi-quantitative analysis is performed)
- Print-out Condition: Print-out conditions

WDS Analysis/WDS Semi-Quant:
WDS qualitative analysis, WDS semi-quantitative analysis

- EOS Condition: Electron optics sysytem conditions
- Semi-Quant.: On-line semi-quantitative analysis conditions (used only when EDS semi-quantitative analysis is performed)
- Print-out Condition: Print-out conditions

ED/WD Quantitative: ED/WD quantitative analysis

- EOS Condition: Electron optics system conditions
- EDS Condition: EDS analysis conditions

Standard Condition: Selection of standard specimens
Print-out Condition: Print-out conditions

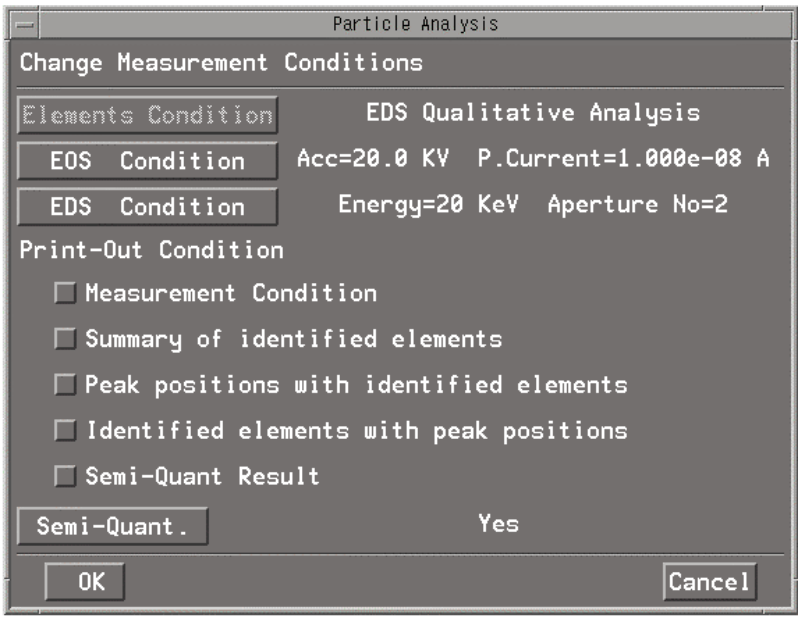


Fig. 8.15 “Change Measurement Conditions” window

8.1.7 Flow Control

Click on the “Flow Control” button in the “Particle Analysis Condition Input” window shown in Fig. 8.2, and the “Flow Control Switch” window will be displayed as shown in Fig. 8.16.
You can temporarily stop the measurement during the measurement in fully automatic particle analysis when the number of particles has exceeded the specified value. When the measurement stops temporarily, the following dialog window will be displayed. If you want to continue the measurement, click on the “OK” button.

Pause after processing particle:
If “Pause” is selected, the measurement stops temporarily when the particle analysis finishes. If “Continue” is selected, the measurement automatically proceeds to the next processing when the particle analysis finishes.

Pause before point analysis:
If “Pause” is selected, the measurement stops temporarily before point analysis is begun. If “Continue” is selected, the measurement automatically proceeds to the next processing.

Pause after point analysis:
If “Pause” is selected, the measurement stops temporarily after point analysis is carried out. If “Continue” is selected, the measurement automatically proceeds to the next processing.

Pre-measurement image:
If “No” is selected, image acquisition and point analysis are executed one after the other. If “Yes” is selected, image acquisition is repeatedly done first, and point analysis is collectively performed later.

Skip point analysis:

If “No” is selected, point analysis is executed. If “Yes” is selected, point analysis is not executed.

Skip particle analysis measurement:

If “No” is selected, particle analysis is executed. If “Yes” is selected, neither particle analysis nor point analysis is performed.

Skip point analysis each point:

If “No” is selected, point analysis is executed. If “Yes” is selected, point analysis stops at that moment and the measurement jumps to the next image acquisition.

End if specified number is over:

If “No” is selected, point analysis is executed. If you select “Yes,” specify the number of point analyses to finish the measurement. Then, check the number of particles measured. If the number of point analyses exceeds the specified number, the measurement finishes.

End if specified type is over:

If “No” is selected, point analysis is executed. If you select “Yes,” specify the chemical type and the number of point analyses. Then, check the number of particles measured of the specified chemical type. If the number of point analyses exceeds the specified number, the measurement finishes.

If you select “Default,” the flow control does not function for any of the items. If you select “OK,” the settings take effect. If you select “Cancel,” all the selections are cancelled.

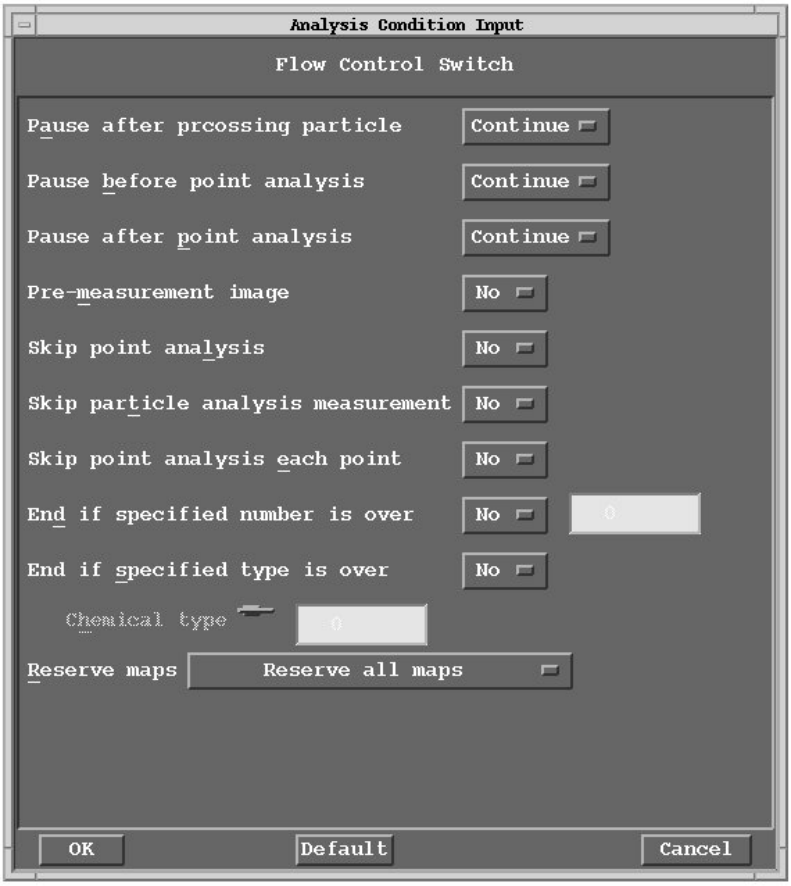


Fig. 8.16 “Flow Control Switch” window

8.1.8 Chemical Type

Click on the “Chemical Type” button in the “Particle Analysis Condition Input” window shown in Fig. 8.2, and the “Chemical Type” window will be displayed as shown in Fig. 8.17.
You can set or correct the chemical type in this window. You can also turn the Learn mode on or off. There is no limit to the number of the chemical type groups that can be recorded. You can specify up to 100 chemical types for each chemical type group.

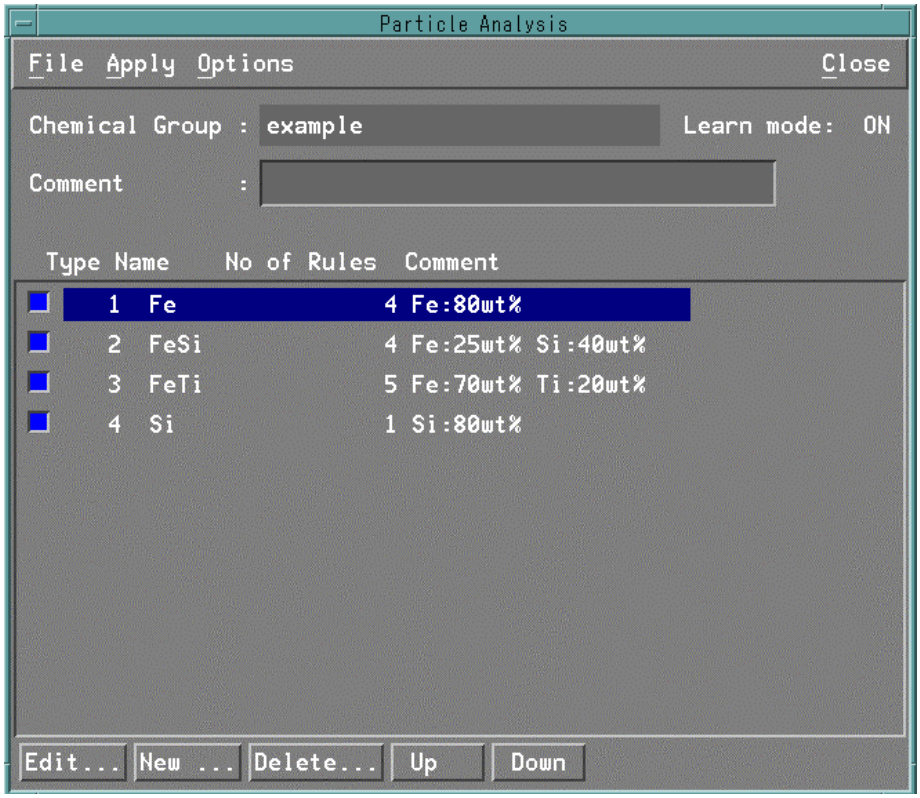


Fig. 8.17 “Chemical Type” window

“File” menu:	Clicking on the “File” menu in the “Chemical Type” window shown in Fig. 8.17 will display a menu. You can specify or store chemical type groups.
Open. . .:	Allows you to open a file of chemical type groups, enabling you to add new ones or changes existing ones.
Save:	Allows you to save the chemical type conditions.
Save as. . .:	Allows you to attach names to chemical type groups and saves them.
Printout. . .:	Allows you to print the conditions and rule of the chemical type that is being edited now.
Close:	Allows you to close the chemical type window.
“Apply” menu:	Clicking on “Apply” in the “Chemical Type” window shown in Fig. 8.17 will display a menu.
Apply chemical type:	Allows you to determine the chemical type. Used to check the measurement results.

Update Learned type list:	Allows you to load the chemical type that has just been learned based upon Apply chemical type. If there is a chemical type that was already learned, it is replaced by the one that has just been learned.
“Options” menu:	Clicking on “Options” in the “Chemical Type” window shown in Fig. 8.17 will display a menu. You can change the chemical type determination parameters.
Configure. . .:	Allows you to open the window to change the parameters used to process the chemical type.
Learn Mode On:	Allows you to turn on or off the Learn mode during chemical type determination.
Show Learned Lists:	Allows you to diplay a list of learned chemical types to the right of the window. If there is no learned chemical type, the list will not be displayed.
Chemical Group:	Allows you to display the name of the chemical type group that is being selected now.
Comment:	Allows you to display and allows you to edit a comment about a chemical type. Up to 40 characters can be input.
Chemical type list:	Allows you to display a list of the registered chemical types. To edit or delete them, click on listed items to highlight them and then click on the “Edit. . .” or “Delete. . .” button.
Edit. . .:	Allows you to display the window on which to edit the chemical types selected from the chemical type list.
New. . .:	Allows you to display the window on which to enter new chemical types.
Delete. . .:	Allows you to delete the chemical type selected from the list of chemical types.
Up:	Allows you to move up the chemical type selected from the list of chemical types.
Down:	Allows you to move down the chemical type selected from the list of chemical types.
>:	Allows you to move the conditions of learned chemical types to the list of chemical types.

Click on “Edit. . .” or “New. . .” in the “Chemical Type” window shown in Fig. 8.17 and the “Chemical Type Edit” window will be displayed as shown in Fig. 8.18.
In this window you can change or edit the rules for each chemical type. You can register up to 100 chemical type rules for each chemical type group.

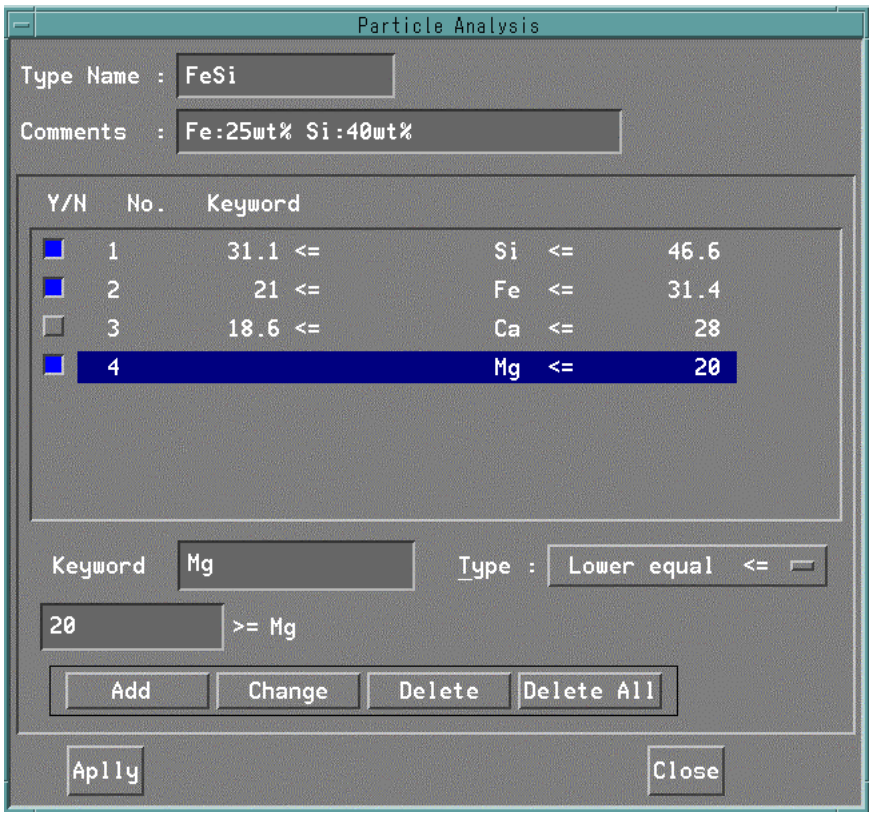


Fig. 8.18 "Chemical Type Edit" window

Type name: Allows you to specify the name to be attached to this chemical type. The maximum number of characters that can be used for naming is 64 alphanumeric characters. Spaces are not allowed.

Comments: Allows you to enter a comment for this chemical type. You can input up to 40 characters.

Chemical type rule list: Allows you to display the rule conditions registered in the chemical type list. Select a listed item (in the chemical type rule list) to change the rule of that item.

Keyword: Allows you to set the keyword for a chemical type rule (Spacesare not allowed). Usually, use an element name for the keyword.
A simple calculation formula can be used. For example, you can judge the chemical type using a simple formula like Mg + Fe or Mg/Fe.

Type: Allows you to specify the operator for determining chemical types. The relationship between each operator and the condition is shown below. Note that v1 and v2 are the specified numeric values, and Key is the keyword for a chemical type rule.

Lower equal: $v1 \geq Key$
Between: $1 \leq Key \leq v2$
Greater equal: $v1 \leq Key$

Equal: v1 = Key

Weight: Adds weight to each conditional formula. As described later, the differences from conditional formulas are calculated. According to the results, the assignment of chemical types are judged.

- Off: The raw values of differences are used.
- Normalize: Each conditional formula is equally weighed.
- × mag: Weight is added based on the values specified by the customer. This type of weighing is used in a formula for assigning trace elements.

Add: Allows you to add a new rule to the list. If the same keyword already exists, a warning will be displayed.

Change: Allows you to change the selected chemical type rules.

Delete: Allows you to delete the selected chemical type rules.

Delete All: Allows you to delete all the chemical rules.

After setting these parameters, click on the “Apply” button to finalize the values.

Click on the “Options” button in the “Chemical Type” window shown in Fig. 8.17 and a menu will be displayed. Then, click on “Configure. . .” in the displayed menu and the “Chemical Type Configure” window will be displayed as shown in Fig. 8.19.

Type Determination: Allows you to select the chemical-type determination conditions.

Sort by delta value (d):
Allows you to calculate the sum of the difference from each chemical type, and selects the chemical type having the smallest difference.

Sort by no. of fit rules (r):
Allows you to calculate the number of conditions met in each chemical type, and the largest number of conditions met is determined to be chemical type.

Decision by faster rules (t):
Allows you to determine the earliest one that satisfies the chemical type conditons as a chemical type.

Data Type: Allows you to determine the kind of data to be used for judgement.

- Wt%: Weight percentage
- Atom%: Atomic percentage
- K-ratio: K ratio
- Intensity: X-ray intensity

Include results of particle: When you want to include the results of particle analysis (such as area and area percentage) in the chemical type determination, highlight this button.

Chemical Type Threshold: Allows you to specify the threshold to use to determine chemical types. The sum of the difference of each chemical type is calculated and the calculated value that is smaller than the value specified here (for example,10.0 in Fig. 8.19) is judged to be the chemical type.

Permit value for rule (%): Allows you to judge chemical types with some allowance specified here added to the chemical type threshold specified for each chemical type. If you specify a larger value here, the rule condition becomes looser.

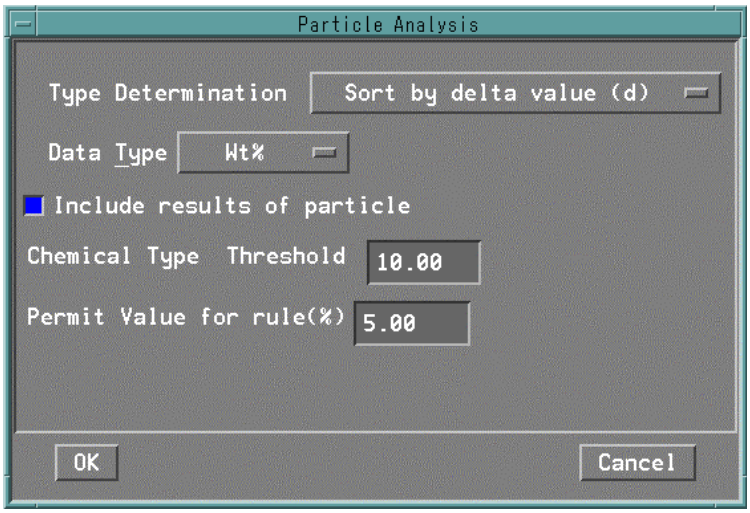


Fig. 8.19 "Chemical Type Configure" window

● How to judge chemical types

Described below is the method for determining chemical type. In on-line particle analysis, first, you carry out particle analysis after acquiring an image; next, you search for the desired particles and move the electron beam to the particle positions; then you carry out the measurement (such as quantitative analysis and semi-quantitative analysis), by which to determine the chemical structure of the particles. You can determine the chemical types using this chemical structure of each particle.

The following is the procedure for chemical type determination.
Compare the analysis results (such as element name and particle measurement item) and the keywords registered as the rule conditions for each chemical type. Execute chemical type determination only when the keywords coincide with the chemical structure. For rule judgment, compare the numeric-value data of the analysis results (i.e. concentration) and the rule condition. If the concentration is within the range of the rule condition value, enter 0, and if the concentration is outside the range of the rule condition value, calculate the difference between the chemical structure and the rule condition value. Carry out this operation for all the rules registered for each chemical type and add the difference for each chemical type. After obtaining the sum of the differences, compare it with the value specified in "Chemical Type Threshold" shown in Fig. 8.19. If the sum of the differences is below the threshold value, it is determined to be the chemical type.

If multiple chemical types exist below the threshold value, chemical types are selected either from the smallest sum of the differences, from the largest number of particles that satisfy the rule conditions or from the earliest registered chemical type conditions. If the sum of the differences of all the chemical types exceeds the threshold value (in other words, if the chemical type cannot be judged), register the chemical structure itself as a new chemical type (when “Learn mode” is on).

8.1.9 Printout Condition

Click on the “Printout Condition” button in the “Particle Analysis Condition Input” window, and the “Printout Condition” window will be displayed as shown in Fig. 8.20.
In this window you can set the conditions for printing out the results of the active measurement.

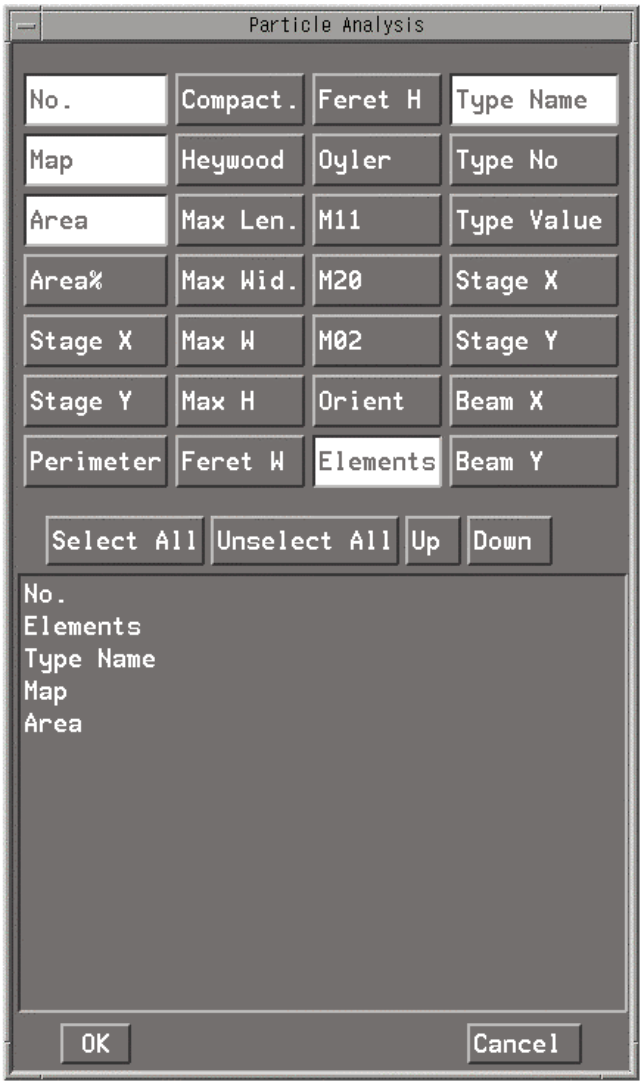


Fig. 8.20 “Printout Condition” window

The above figure contains a list of items to print. The items from “Area” to “Orient” are the measurement items in particle analysis.

☞ For the details of these items, refer to Sect. 7.9.

Described below are the other items.

No.:	Number of point analyses
Elements:	Names and weight percentages are printed for up to three elements.
Type Name:	Chemical type name
Map:	Image number
Type No.:	Number of chemical type
Type Value:	Numerical value used for chemical type determination
Stage X,Y:	Stage coordinates
Beam X,Y:	Beam position coordinates

The items are printed on a first-selected-first-printed basis. To change the order of printing, select listed items displayed in the lower part of the window and change them by clicking on the “Up” or “Down” button. When you print the items during actual measurement, a text window will be displayed in the upper right of the display screen and the printed items will be displayed in the text window as shown in Fig. 8.23.

8.1.10 Condition Load

Click on the “Condition Load” button in the “Particle Analysis Condition Input” window, and the “Condition File Load” window will be displayed as shown in Fig. 8.21.
In this window you can call out the analysis conditions for fully automatic particle analysis that have already been registered, such as EOS Condition, Signal Condition, Analysis Condition, Flow Condition, Printout Condition and Chemical Type. Click on the analysis number you want to call out and click on the “Load” button, and then you can call out the analysis conditions of that analysis number.

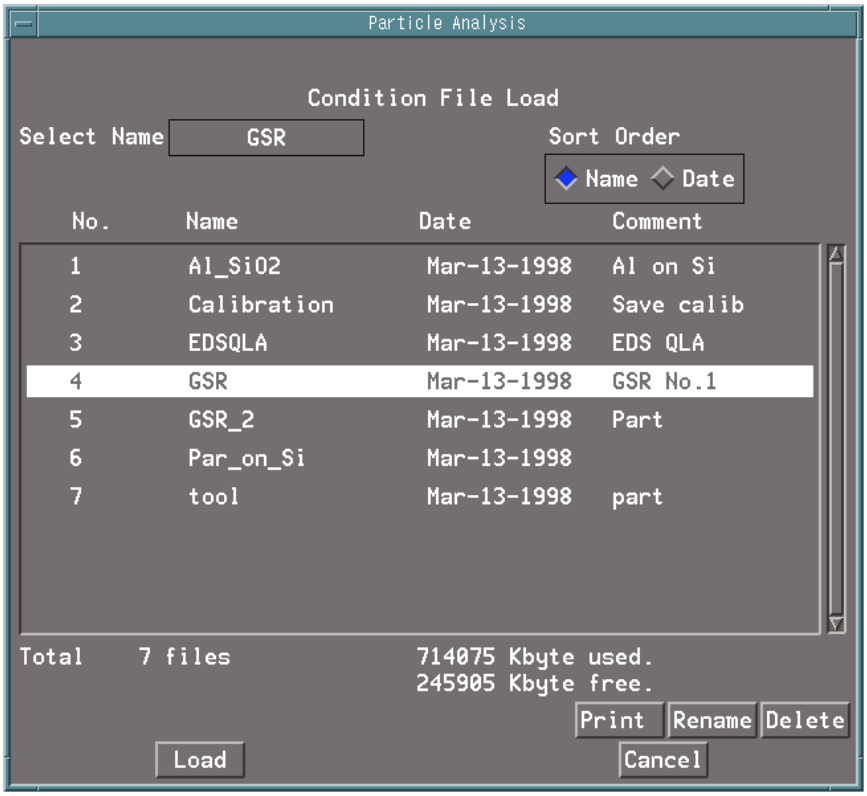


Fig. 8.21 “Condition File Load” window

8.1.11 Condition Save

Click on the “Condition Save” button in the “Particle Analysis Condition Input” window, and the “Condition Save” window will be displayed.
In this window you can record the analysis conditions for fully automatic particle analysis that you have set (such as EOS Condition, Signal Condition, Analysis Condition, Flow Condition, Printout Condition and Chemical Type) in a file. To store the analysis conditions in a new file, click on the “New” button; enter a file name and a comment; then click on the “OK” button. To overwrite on an existing file, select the file name and click on the “Save” button.

8.1.12 Preset Measurement

Click on the “Preset Measurement” button in the “Particle Analysis Condition Input” window, and the “Preset Measurement” window will be displayed as shown in Fig. 8.22.
Clicking on the “Acquire” button will start measurement. Example windows during measurement are shown in Fig. 8.23. The top left window is a fully automatic particle analysis window, in which the state of particle analysis, the present beam position and so forth are being monitored. The bottom left window is a text window in which the results of EDS semi-quantitative analysis are displayed. The top right window is the one in which chemical type determination is displayed. A pie chart of EDS semi-quantitative analysis is displayed in the middle right window. The bottom right window is a monitor window showing the progress of measurement.

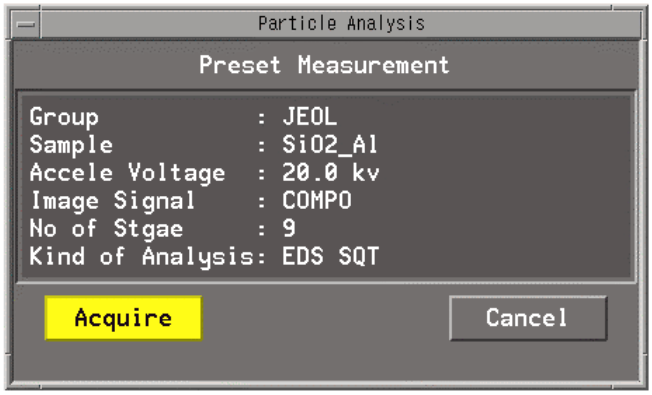


Fig. 8.22 “Preset Measurement” window

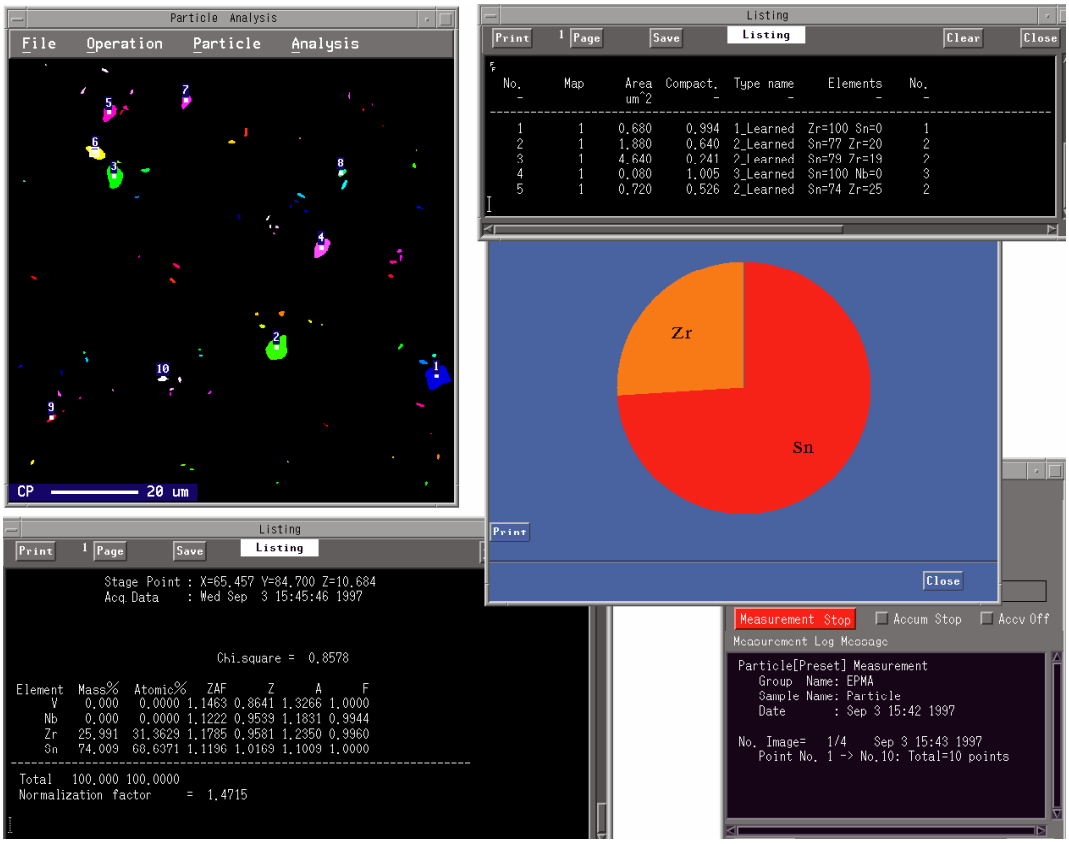


Fig. 8.23 Windows during measurement

8.2 Preset Analysis

Select “Preset Analysis” from the “Analysis” pull-down menu shown in Fig. 8.1, and the “Preset Analysis” window will be displayed.
If measurement conditions have been established, you can start measurement in this window. In this case the realtime monitor is also turned on automatically.

8.3 Realtime Monitor

Select “Realtime Monitor” from the “Analysis” pull-down menu shown in Fig. 8.1, and the “Particle Analysis Realtime Monitor” window will be displayed as shown in Fig. 8.24.
In this window you can monitor the state of particle-analysis progress. When you are executing particle-analysis commands during fully automatic particle analysis, the commands are highlighted.

Original map:	Allows you to display the original image.
Show stage pos.:	Allows you to display the position of point analysis on an image.
Start monitor:	Allows you to start the realtime monitor.
End monitor:	Allows you to stop the realtime monitor.
Close:	Allows you to close the window.

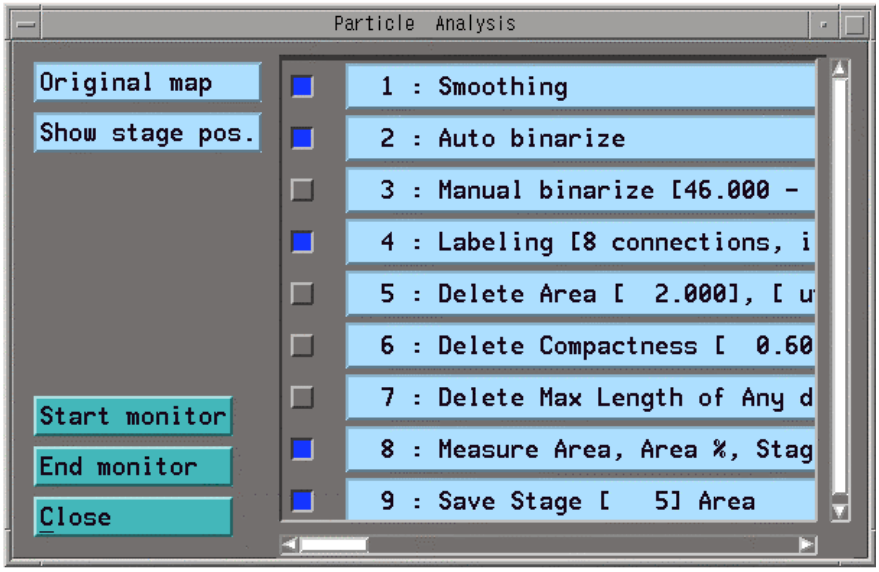


Fig. 8.24 “Particle Analysis Realtime Monitor” window

8.4 Start Monitor

Select “Start monitor” from the “Analysis” pull-down menu, and the realtime monitoring of fully automatic particle analysis will begin. Clicking on “Start monitor” again will stop the realtime monitoring.
Once the realtime monitoring is started, the state of beam-image acquisition is monitored in real time while beam images are being acquired. Also, a binary image, a labeled image, point-analysis coordinates and so forth are displayed during particle analysis. During point analysis, the beam position is displayed as a small rectangular mark on the display window.

8.5 Show

You can display the original image, binary image, labeled image and stage-position coordinates in the display window.

Stage position:	Allows you to display the point-analysis coordinates.
Original map:	Allows you to display the original image.
Binary map:	Allows you to display the binary image.
Label map:	Allows you to display the labeled image.

8.6 Summary

After you have finished the measurement, click on the “Summary” button in the “Analysis” pull-down menu shown in Fig. 8.1 and the “Summary ” window will be displayed as shown in Fig. 8.25.
In this window you can make a summary of the results of qualitative analysis, semi-quantitative analysis and quantitative analysis and print the results of particle analysis.

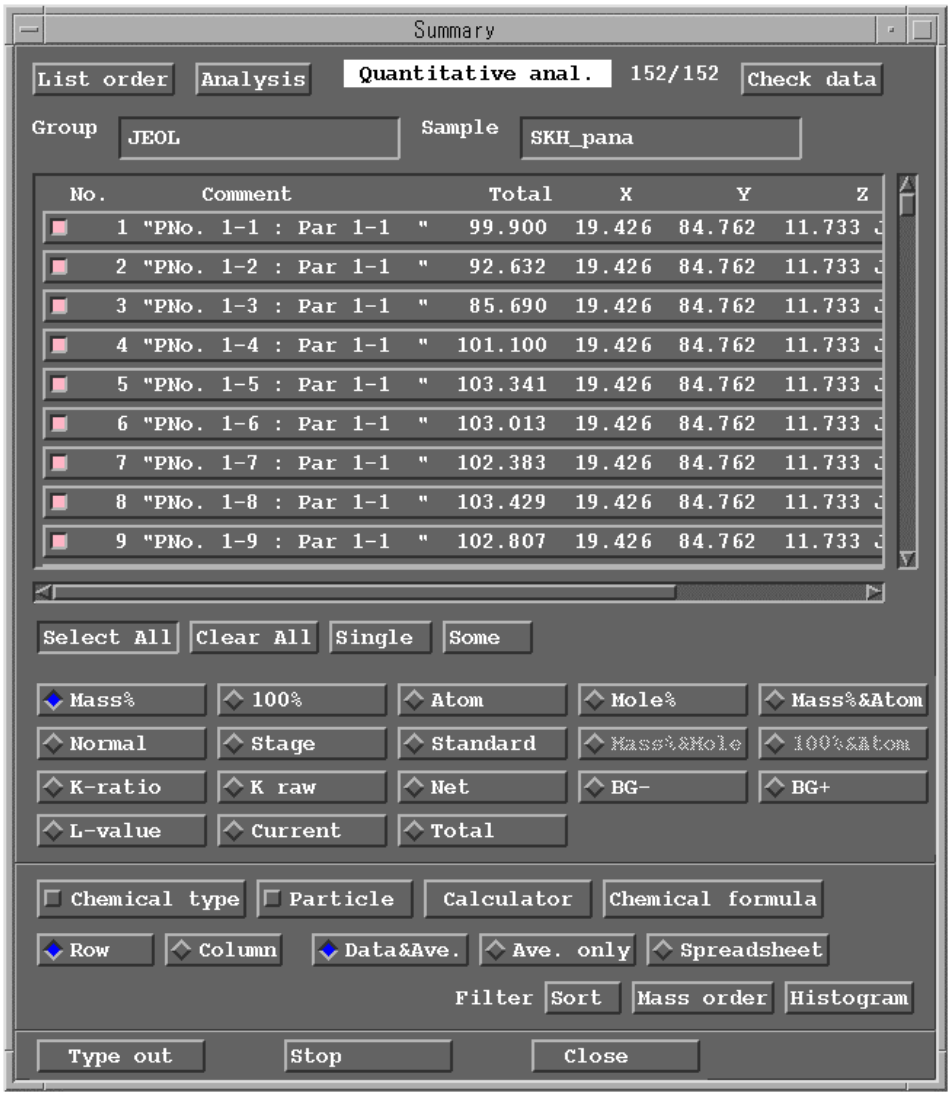


Fig. 8.25 “Summary” window

Click on the “Analysis” button in the “Summary” window, and you can select EDS qualitative analysis, WDS qualitative analysis, EDS semi-quantitative analysis, WDS semi-quantitative analysis, WD/ED quantitative analysis or particle analysis. When you print out the results of qualitative analysis, a list of the identified elements classified into A and B ranks is printed out. In addition, there are some more menus for particle analysis as follows.

Chemical type:	Allows you to print out all chemical types and composition data, simultaneously. They are printed after the sample number is printed out.
Particle Analysis:	Allows you to display a list of items for which particle measurement has been performed. Select the items you want to print out. They are printed out before element information is printed out.
Mass Order:	Allows you to display a window on which to specify the number of elements you want to print out. The names of the elements and their weight percentages are printed in order from high to low values. This button (Wt. Order) is used when elements to be measured are not fixed as for example in semi-quantitative analysis.
Sort:	Allows you to display a window on which to select elements to be sorted. In this window you can select elements in the order of weight concentration from high to low or in the order of particle size from large to small.
Histogram:	Allows you to print the histogram distribution for each specified item.

8.7 Phase Analysis (Option)

If you use the optional Phase Analysis program, you can combine particle analysis results and element measurement results. In the “Analysis” section of the “Phase Analysis” window shown in Fig. 8.26 you can additionally select WDS semi-quantitative analysis, EDS semi-quantitative analysis and particle analysis. If you select “Particle” (for particle analysis), you can process the measurement results of all the particles. If you select “Semi” (for semi-quantitative analysis) or “Quant” (for quantitative analysis), you can use the measurement results of the particles for which these analyses were performed. If you execute WDS semi-quantitative analysis, EDS semi-quantitative analysis or quantitative analysis in fully automatic particle analysis, selection items for particle measurement are added in the “Elements” window of “Phase Analysis“ shown in Fig. 8.27.

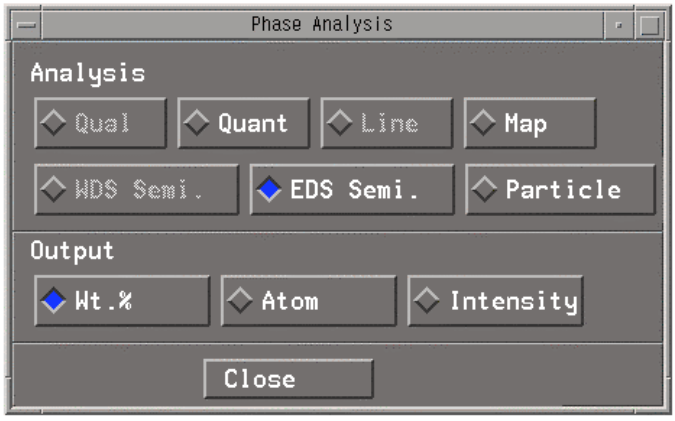


Fig. 8.26 “Analysis” section of “Phase Analysis” window

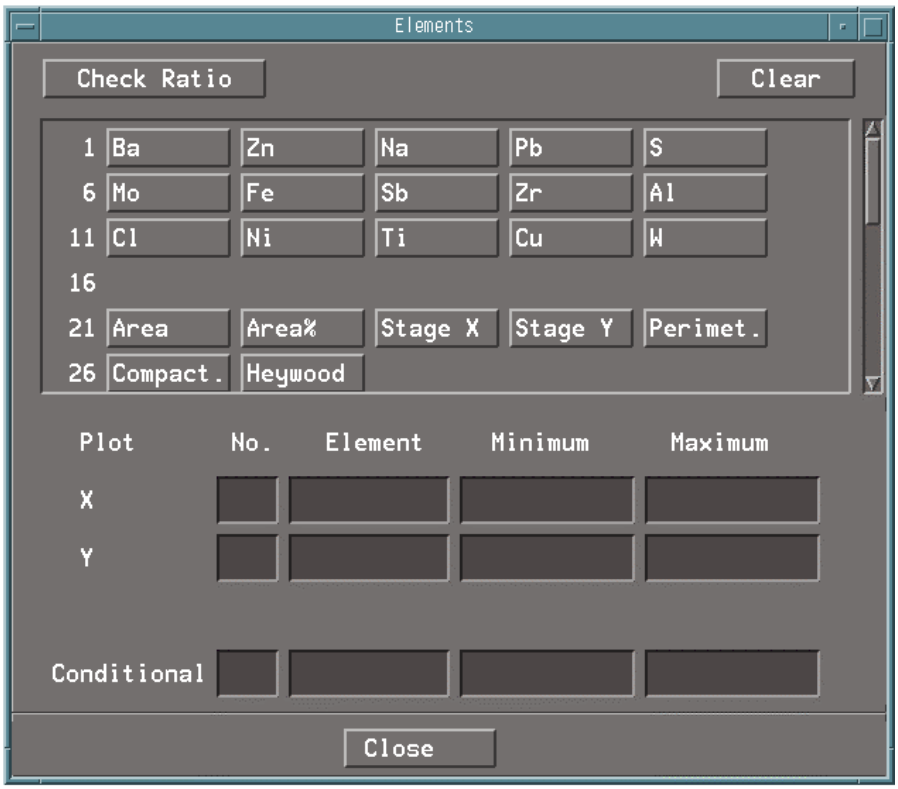


Fig. 8.27 “Elements” window of Phase Analysis

In this window you can not only see the ordinary analysis such as the relationship among elements, but also combine the particle measurement results and the element information and process the combined results. For example, Fig. 8.28 shows the relationship between area and compactness in particle measurement, and Fig. 8.29 shows the relationship between area and element concentration.

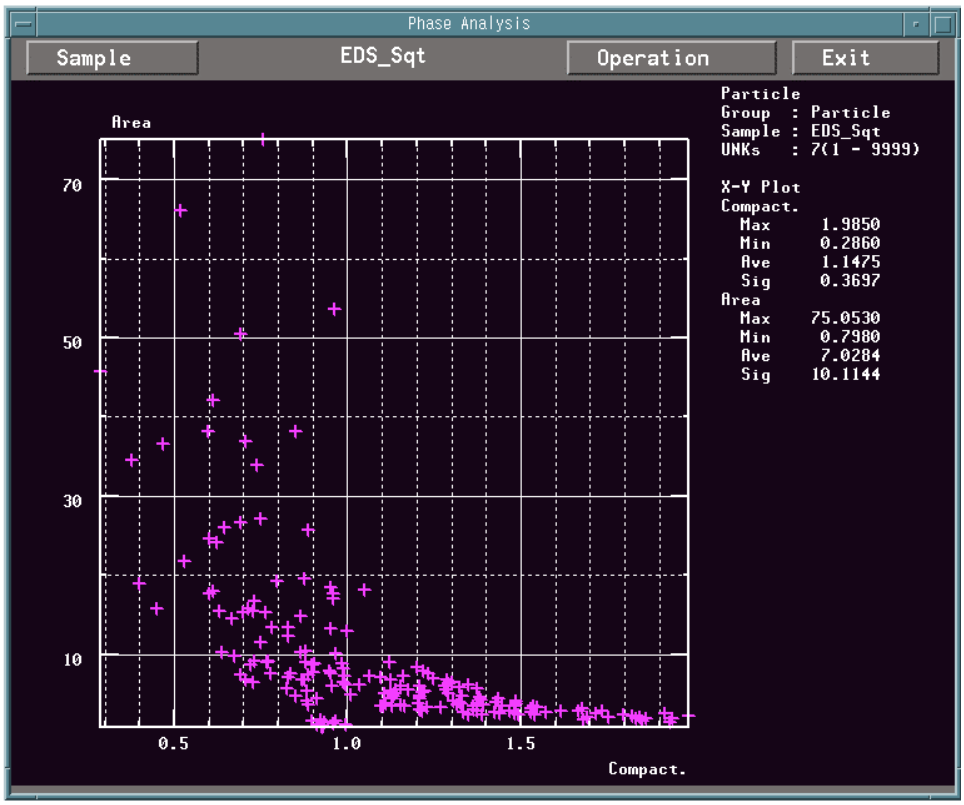


Fig. 8.28 Display example of area and compactness

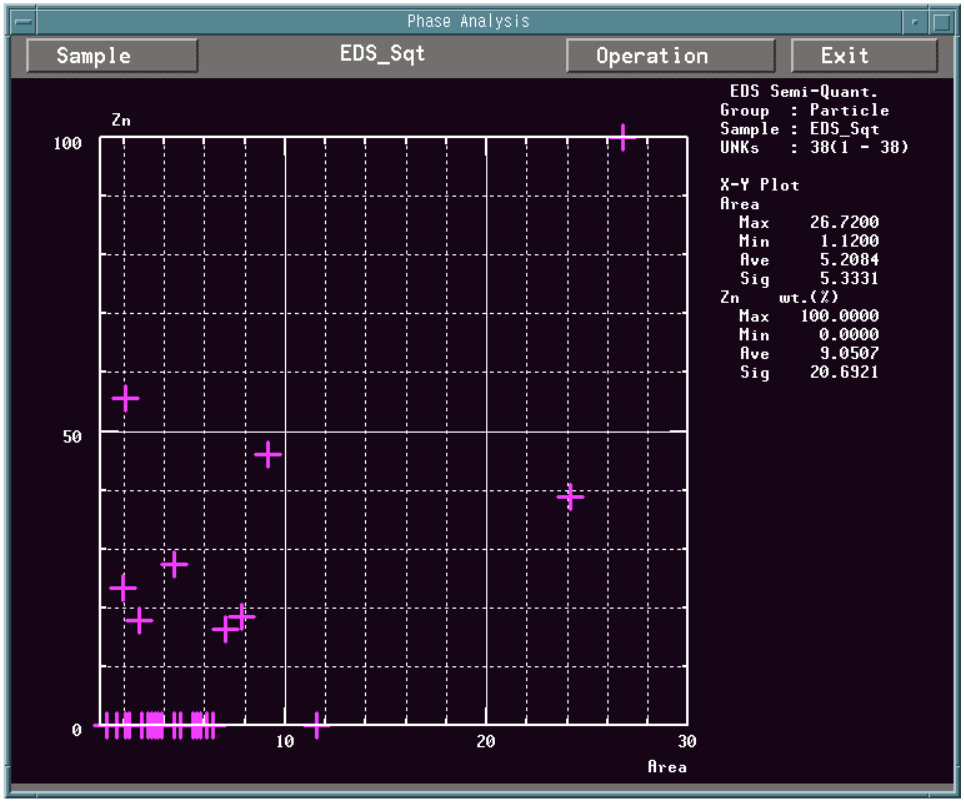


Fig. 8.29 Display example of area and element concentration (Zn)

Chemical Type window

You can color-code and display the analysis results for each chemical type. Clicking on the Chemical type button in the Operation window of the Phase Analysis program displays the Chemical Type window (Fig. 8.30).

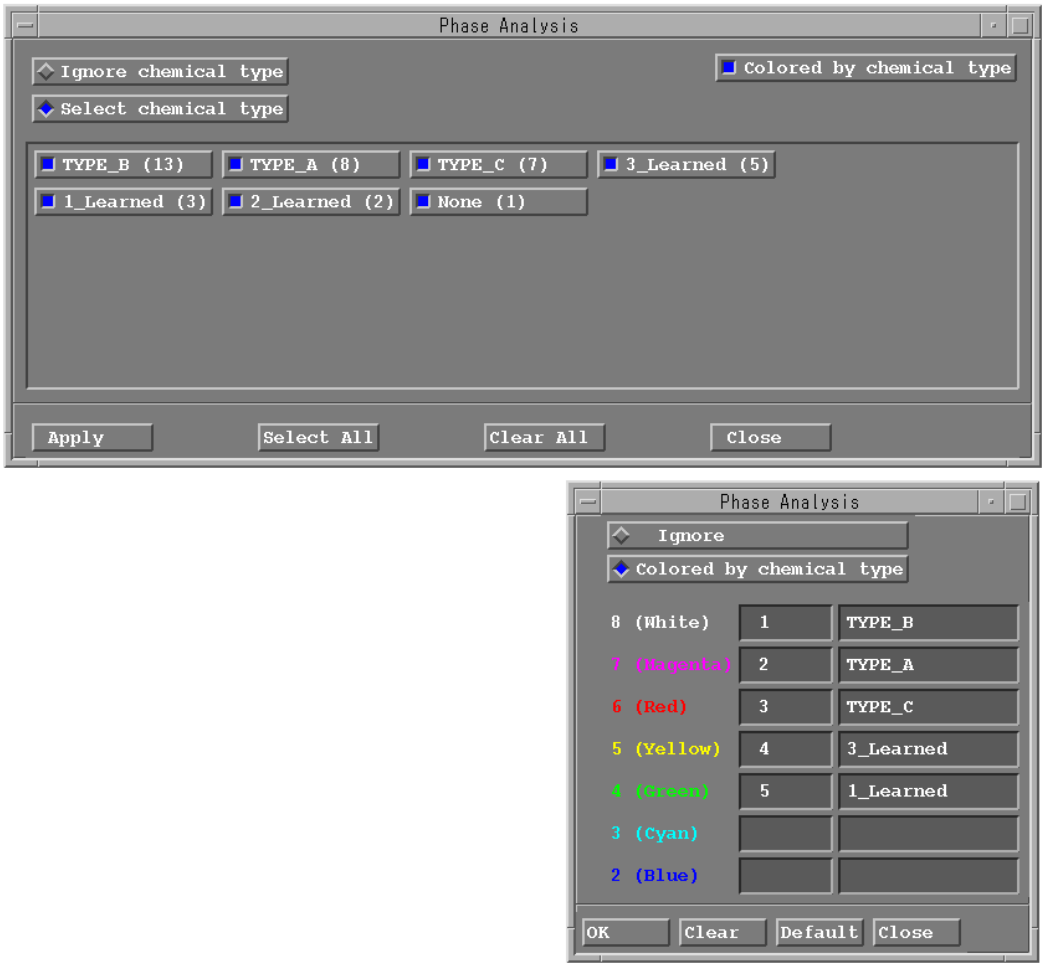


Fig. 8.30 Chemical Type window

The chemical types that appear are listed in the order of frequency of appearance (from high to low). If you wish to display only the selected chemical types, click on the Select chemical type button to select them, then on the Apply button.
If you want to display the analysis results color-coded for each chemical type, click on the Colored by chemical type button and assign colors to the selected chemical types.