

Sample Alignment (2D detector) Part

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1 How to set Part conditions

In this chapter, how to set the **Sample Alignment (2D detector)** Part conditions is described.

1.1 Setting conditions

Set the basic conditions in the **Sample Alignment (2D detector)** dialog box.

The scan conditions and slit conditions of the sample alignment are determined based on the basic conditions. The scan conditions and slit conditions can also be customized.

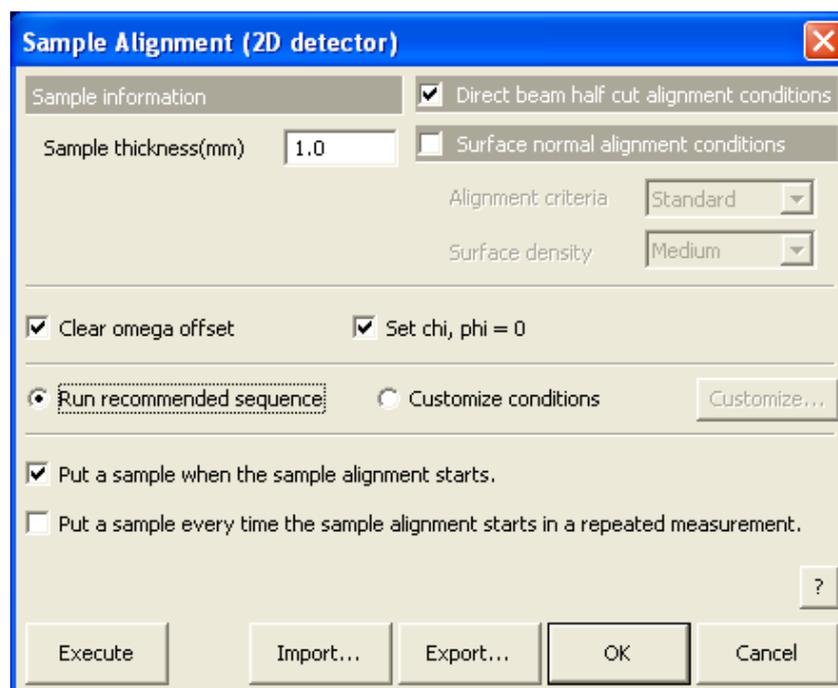


Fig. 1.1.1 Sample Alignment (2D detector) dialog box

Sample thickness (mm)

Enter the sample thickness. For a thin film sample, enter the overall thickness of the sample, including the thickness of the substrate.

Direct beam half cut alignment conditions

Check the **Direct beam half cut alignment conditions** box to execute the direct beam half cut alignment.

Surface normal alignment conditions

Check the **Surface normal alignment conditions** box to execute the surface normal alignment.

Alignment criteria

Select the alignment criteria of the surface normal alignment.

Standard	Performs the surface normal alignment twice.
Fine	Repeats the surface normal alignment up to five times until the alignment results converge.

Surface density

Select the nominal density of the surface layer from **Very low**, **Low**, **Medium**, or **High**. The 2-theta scattering angles, depending on the wavelength, shown in the table below are used for the surface normal alignment.

Surface density	Nominal density	2-theta scattering angles			
		Mo wavelength	Cu wavelength	Co wavelength	Cr wavelength
Very low	1.0 g/cm ³ or lower	0.09 deg	0.20 deg	0.23 deg	0.30 deg
Low	1.0~2.5 g/cm ³	0.18 deg	0.40 deg	0.46 deg	0.59 deg
Medium	2.5~4.0 g/cm ³	0.23 deg	0.50 deg	0.58 deg	0.74 deg
High	4.0 g/cm ³ or higher	0.28 deg	0.60 deg	0.70 deg	0.89 deg



Tip: When **Surface density** is set to **Unknown**, the surface normal alignment is performed at the 2-theta scattering angle used when **Medium** is selected for **Surface density**.

A surface layer is a layer that is approximately 10 nm thick or greater and closest to the surface. For example, if the layer (layer 1) closest to the surface is 2 nm thick and the next layer (layer 2) is 30 nm thick, **Surface density** should be set to the density of the second layer.

Clear omega offset

When the **Clear omega offset** box is checked, the sample alignment starts after setting the omega zero offset value to the value registered as the optics alignment result.

Set chi, phi = 0

When the **Set chi, phi = 0** box is checked, the sample alignment starts after driving the chi and phi axes to the datum point (0°, excluding the zero offset value).



Tip: If the results of the previous sample alignment are kept, the next sample alignment uses this position as a reference and may not work correctly. In ordinary cases, check the **Clear omega offset** and **Set chi, phi = 0** boxes.

Run recommended sequence Performs the sample alignment using the recommended sequence.

Customize conditions

Performs the sample alignment under the conditions specified in the **Customize** dialog box.

Customize

When the **Customize conditions** radio button is selected, click the **Customize** button, then set the scan conditions and slit conditions.


[1.2 Customizing scan conditions and slit conditions](#)


Tip: It is recommended to execute both the direct beam half cut alignment and the surface normal alignment unless there is a specific reason not to. Execute the surface normal alignment when a precise sample alignment is required by the application.

Put a sample when the sample alignment starts.

If the sample is mounted (or changed) before the sample alignment starts, check the **Put a sample when the sample alignment** box. If the sample alignment is performed using the currently-mounted sample, uncheck the **Put a sample when the sample alignment** box.

Put a sample every time the sample alignment starts in a repeated measurement.

If the sample is changed every time the sample alignment starts in a repeated measurement using the loop Parts or XY mapping Parts, check the **Put a sample every time the sample alignment starts in a repeated measurement** box. If the sample is mounted during the first cycle only, uncheck the **Put a sample every time the sample alignment starts in a repeated measurement** box.

Execute

Executes the sample alignment under the conditions specified in the **Sample Alignment (2D detector)** dialog box.



CAUTION: Clicking the **Cancel** button after executing the sample alignment does not cancel the specified conditions.



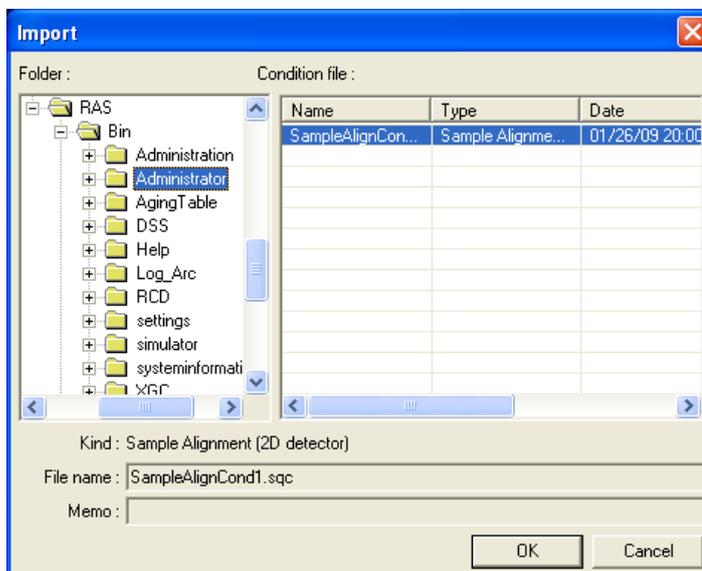
Tip: The sample alignment is executed with the **Sample Alignment (2D detector)** dialog box open. While the sample alignment is running, the Part conditions cannot be changed. They can be changed again after the alignment has been completed.

The setting of  (Show confirmation messages) on the flow bar becomes invalid.

Import

Loads the saved Part conditions.

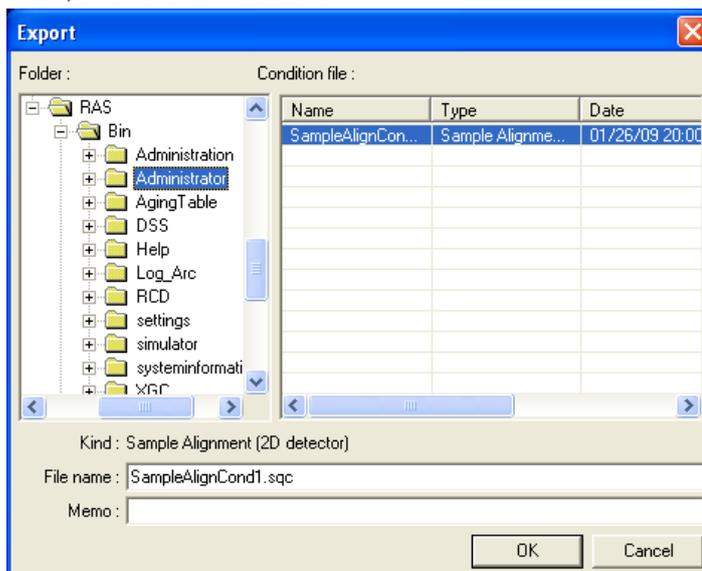
Clicking the **Import** button opens the **Import** dialog box. Select the folder including the file you want to import from the **Folder** tree view. In the **Condition file** list, select the condition file you want to import and click the **OK** button to load the Part conditions.



Export

Saves the specified Part conditions in a file.

Clicking the **Export** button opens the **Export** dialog box. From the **Folder** tree view, select a destination folder to save the conditions file then enter a file name in the **File name** box. Enter comments in the **Memo** box, if needed. After entering them, click the **OK** button.



OK Sets the conditions and closes the dialog box.



CAUTION: When selecting another Package measurement or switching the task to the **Manual Control** task, etc. the specified conditions will be cancelled. To save the specified conditions in a file, click the **Export** button and save the conditions.

Cancel Does not set the conditions and closes the dialog box.



Tip: Clicking the **Cancel** button also cancels the conditions specified in the **Customize** dialog box.

? Opens the online help of this Part.

1.2 Customizing scan conditions and slit conditions

If you want to customize the scan conditions and slit conditions of the sample alignment, set the conditions in the **Customize** dialog box.

 Tip: Refer to [2 Sample alignment sequence](#) to set the scan conditions and slit conditions.

Customize - Sample Alignment (2D detector)

Sample information

Sample thickness(mm)

Direct beam half cut alignment conditions

Surface normal alignment conditions

Alignment criteria

Surface density

Clear omega offset

Set chi, phi = 0

Slit conditions

IS(mm) IS L(mm)

Scattering angle for alignment

Alignment 2-theta(deg)

Direct beam half cut alignment measurement conditions

Incident attenuator

Intensity threshold(cps)

Scan axis	Range	Start (mm)	Stop (mm)	Step (mm)	Duration time (sec)	Delta (mm)
Z	Absolute	-3.0000	1.0000	0.0500	0.50	1.0000

Scan axis	Range	Start (deg)	Stop (deg)	Step (deg)	Duration time (sec)	Delta (deg)
Omega	Absolute	-2.0000	2.0000	0.1000	0.50	1.0000

Surface normal alignment measurement conditions

Incident attenuator

Intensity threshold(cps)

Repeat

Scan axis	Range	Start (mm)	Stop (mm)	Step (mm)	Duration time (sec)	Delta (mm)
Z	Relative	-0.3000	0.3000	0.0100	0.50	0.3000

Exec.	Scan axis	Range	Start (deg)	Stop (deg)	Step (deg)	Duration time (sec)	Delta (deg)
	Omega	Relative	-0.3000	0.3000	0.0100	0.50	0.3000
<input checked="" type="checkbox"/>	Chi	Relative	-3.000	3.000	0.050	0.50	3.000

Fig. 1.2.1 Customize dialog box

Sample information		<input checked="" type="checkbox"/> Direct beam half cut alignment conditions	
Sample thickness(mm)	<input type="text" value="1.0"/>	<input type="checkbox"/> Surface normal alignment conditions	
		Alignment criteria	<input type="text" value="Standard"/>
		Surface density	<input type="text" value="Medium"/>

Sample thickness (mm)

Enter the sample thickness in mm. For a thin film sample, enter the overall thickness of the sample, including the thickness of the substrate.

Direct beam half cut alignment conditions

Check the **Direct beam half cut alignment conditions** box to execute the direct beam half cut alignment.

Surface normal alignment conditions

Check the **Surface normal alignment conditions** box to execute the surface normal alignment.

Alignment criteria

Select the alignment criteria of the surface normal alignment.

Standard	Performs the surface normal alignment twice.
Fine	Repeats the surface normal alignment up to five times until the alignment results converge.

Surface density

Select the nominal density of the surface layer from **Very low**, **Low**, **Medium**, or **High**. The 2-theta scattering angles, depending on the wavelength, shown in the table below are used for the surface normal alignment.

Surface density	Nominal density	Scattering angle 2-theta			
		Mo wavelength	Cu wavelength	Co wavelength	Cr wavelength
Very low	1.0 g/cm ³ or lower	0.09 deg	0.20 deg	0.23 deg	0.30 deg
Low	1.0~2.5 g/cm ³	0.18 deg	0.40 deg	0.46 deg	0.59 deg
Medium	2.5~4.0 g/cm ³	0.23 deg	0.50 deg	0.58 deg	0.74 deg
High	4.0 g/cm ³ or higher	0.28 deg	0.60 deg	0.70 deg	0.89 deg



Tip: When **Surface density** is set to **Unknown**, the surface normal alignment is performed at the 2-theta scattering angle used when **Medium** is selected for **Surface density**.

A surface layer is a layer that is approximately 10 nm thick or greater and closest to the surface. For example, if the layer (layer 1) closest to the surface is 2 nm thick and the next layer (layer 2) is 30 nm thick, the **Surface density** should be set to the density of the second layer.

Clear omega offset
 Set chi, phi = 0

Clear omega offset

When the **Clear omega offset** box is checked, the sample alignment starts after setting the omega zero offset value to the value registered as the optics alignment result.

Set chi, phi = 0

When the **Set chi, phi = 0** box is checked, the sample alignment starts after driving the chi and phi axes to the datum point (0°, excluding the zero offset value).

 Tip: If the results of the previous sample alignment are kept, the next sample alignment uses this position as a reference and may not work correctly. In ordinary cases, check the **Clear omega offset** and **Set chi, phi = 0** boxes.

Slit conditions		Scattering angle for alignment
IS(mm)	IS L(mm)	
<input type="text" value="2.000"/>	<input type="text" value="10.0"/>	Alignment 2-theta(deg) <input type="text" value="0.5000"/>

IS (mm)

Enter the incident slit width.

IS L (mm)

Enter the incident length limiting slit length.

Alignment 2-Theta (deg)

Enter the 2-theta scattering angle in degrees for the surface normal alignment.

Direct beam half cut alignment measurement conditions

Incident attenuator Intensity threshold(cps)

Scan axis	Range	Start (mm)	Stop (mm)	Step (mm)	Duration time (sec)	Delta (mm)
Z	Absolute	-3.0000	1.0000	0.0500	0.50	1.0000

Scan axis	Range	Start (deg)	Stop (deg)	Step (deg)	Duration time (sec)	Delta (deg)
Omega	Absolute	-2.0000	2.0000	0.1000	0.50	1.0000

Direct beam half cut alignment measurement conditions

Check the **Direct beam half cut alignment measurement conditions** box to execute the direct beam half cut alignment.

Incident attenuator

Select **ON** when you use the incident attenuator for the direct beam half cut alignment. Select **OFF** when you don't use the incident attenuator.

Intensity threshold (cps)

Enter the x-ray intensity. This value is used to interrupt scans after peak detection.

Start (mm)

Enter the start position of the Z scan.

Stop (mm)

Enter the stop position of the Z scan.

Step (mm)

Enter the step width of the Z scan.

Duration time (sec)

Enter the duration time of the Z step.

Delta (mm)

Enter the relative range of the second and subsequent Z scans. The value (position determined in the first scan) +/- (delta) is the scan range for the second and subsequent scans.

Start (deg)

Enter the start angle of the omega scan.

Stop (deg)

Enter the stop angle of the omega scan.

Step (deg)

Enter the step width of the omega scan.

Duration time (sec)

Enter the duration time of the omega step.

Delta (deg)

Enter the relative range of the second and subsequent omega scans. The value (position determined in the first scan) +/- (delta) is the scan range for the second and subsequent scans.

<input checked="" type="checkbox"/> Surface normal alignment measurement conditions								
Incident attenuator		ON	Intensity threshold(cps)		1000	Repeat		3
	Scan axis	Range	Start (mm)	Stop (mm)	Step (mm)	Duration time (sec)	Delta (mm)	
	Z	Relative	-0.3000	0.3000	0.0100	0.50	0.3000	
Exec.	Scan axis	Range	Start (deg)	Stop (deg)	Step (deg)	Duration time (sec)	Delta (deg)	
	Omega	Relative	-0.3000	0.3000	0.0100	0.50	0.3000	
<input checked="" type="checkbox"/>	Chi	Relative	-3.000	3.000	0.050	0.50	3.000	

Surface normal alignment measurement conditions

Check the **Surface normal alignment measurement conditions** box to execute the surface normal alignment.

Incident attenuator

Select **ON** when you use the incident attenuator for the surface normal alignment. Select **OFF** when you don't use the incident attenuator.

Intensity threshold (cps)

Enter an x-ray intensity. This value is used to interrupt axial scans after peak detection.

Repeat

Select the number of surface normal alignment to be repeated.

Start (mm)

Enter the relative distance of the start position of the Z scan from the position of the Z axis at the start of the scan.

Stop (mm)

Enter the relative distance of the stop position of the Z scan from the position of the Z axis at the start of the scan.

Step (mm)

Enter the step width of the Z scan.

Duration time (sec)

Enter the duration time of the Z step.

Delta (mm)

Enter the relative range of the second and subsequent Z scans. The value (position determined in the first scan) +/- (delta) is the scan range for the second and subsequent scans.

Exec.

Check the **Exec.** box to execute chi-axis alignment.

Start (deg)

Enter the relative distance of the start position of each scan from the position of the scan axis at the start of the scan.

Stop (deg)

Enter the relative distance of the stop position of each scan from the position of the scan axis at the start of the scan.

Step (deg)

Enter the step width of each scan.

Duration time (sec)

Enter the duration time of each step.

Delta (deg)

Enter the relative range of the second and subsequent scans of each axis. The value (position determined in the first scan) +/- (delta) is the scan range for the second and subsequent scans.

**Set recommended values**

Sets the conditions in the **Slit conditions**, **Scattering angle for alignment**, **Direct beam half cut alignment measurement conditions**, and **Surface normal alignment measurement conditions** sections to the recommended values based on the conditions specified in the **Sample information** and **Surface normal alignment conditions** sections.

Close

Closes the **Customize** dialog box.

2 Sample alignment sequence

The sample alignment is performed automatically. However, the sample spacer, wafer sample plate, sample, and parts such as optical devices must be installed (or removed) manually as instructed by messages displayed on the screen.

Described below is the general sample alignment sequence.

2.1 Direct beam half cut alignment

- (1) Install the sample spacer, wafer sample plate, sample, and incident length limiting slit as instructed by the messages displayed on the screen.
- (2) Adjust the incident slit widths as specified in the recommended or customized conditions.
- (3) Drive each axis of the goniometer to the initial position ($2\text{-theta} = 0.0000^\circ$, $\omega = 0.0000^\circ$).
- (4) Scan the Z axis and determine the position at which the incident x-ray beam is blocked and reduced to 50% intensity by the sample.

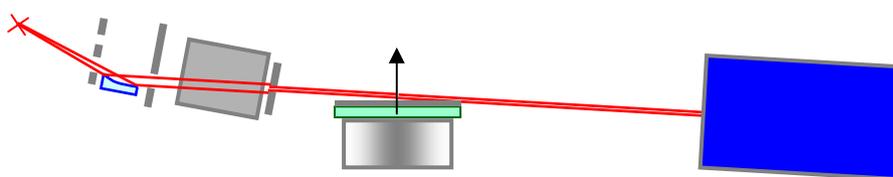


Fig. 2.1.1 Alignment based on Z scan

- (5) Drive the Z axis to the position determined in step (4).
- (6) Scan the omega axis and determine the position (profile peak position) at which the incident x-ray beam is parallel to the sample surface.

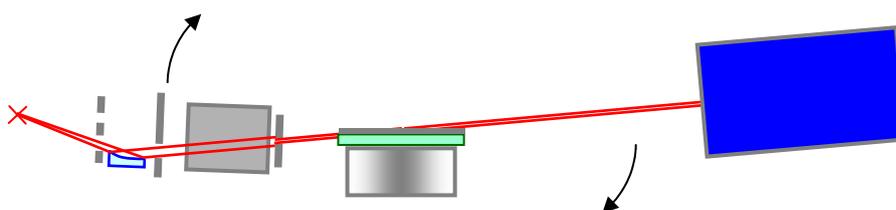


Fig. 2.1.2 Alignment based on omega scan

- (7) Drive the omega axis to the profile peak position.
- (8) Repeat steps (4) through (7).
- (9) Repeat steps (4) and (5).

- (10) After the alignment has been completed, the sample surface is parallel to the incident x-ray beam. The sample surface also coincides with the center of rotation of the goniometer axes.

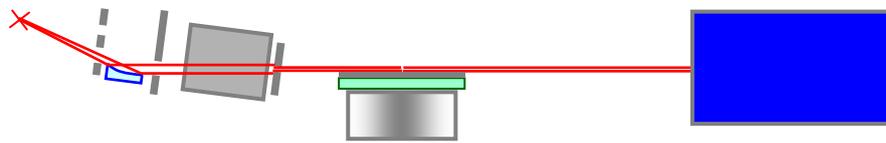


Fig. 2.1.3 After alignment

- (11) Change the omega zero offset value so that omega is 0.0000° under the conditions described in step (10).

2.2 Surface normal alignment

- (1) Drive the 2-theta/omega axes to the alignment scattering angle specified in the recommended or customized conditions.
- (2) Scan the omega axis and determine the position (profile peak position) at which the incident angle of the x-ray beam on the sample surface equals half of the 2-theta scattering angle.

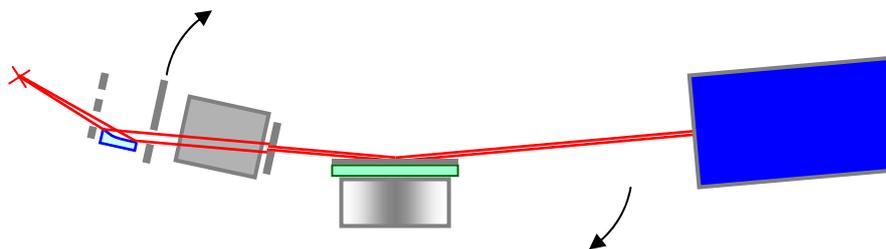


Fig. 2.2.1 Alignment based on omega scan

- (3) Drive the omega axis to the profile peak position.
- (4) Scan the Z axis and determine the position (profile peak position) at which the sample surface coincides with the center of rotation of the goniometer axes.

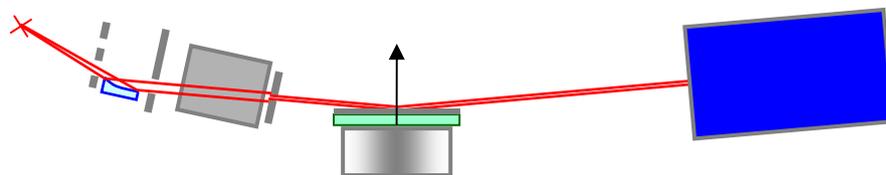


Fig. 2.2.2 Alignment based on Z scan

- (5) Drive the Z axis to the profile peak position.

- (6) Repeat the alignment process described in steps (2) through (5) for the number of times specified in the recommended or customized conditions.
- (7) After the alignment has been completed, the incident and exit angles of the x-ray beam on the sample surface are identical and equal to half of the scattering angle. The sample surface also coincides with the center of rotation of the goniometer axes.

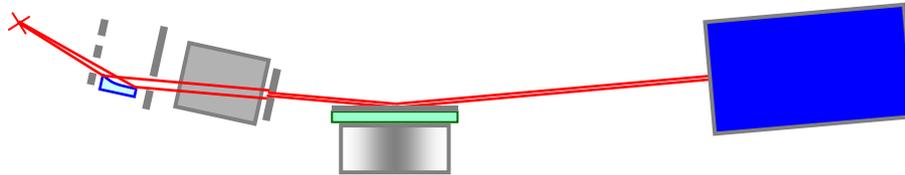


Fig. 2.2.3 After alignment

- (8) Change the omega zero offset values so that $\omega = 2\text{-}\theta/2$.
- (9) Drive the 2-theta/omega axes to 0.0000° .