

Technical Solution of X-ray Diffractometer

(Model: DW-Y3500A)

Basic description

X-ray diffractometer is a very common and widely used analytical instrument, mainly used in qualitative or quantitative analysis of the phase of the sample, crystal structure analysis, material structure analysis, macro-stress or micro-stress measurement, crystal size measurement, crystallinity measurement, etc. It is widely used in In materials science, physics, chemistry, chemical industry, metallurgy, minerals, medicine, building materials, ceramics...

It can accurately do qualitative and quantitative phase analysis of metal and non-metallic polycrystalline samples.

Base on this standard configuration, if we install related accessories, it can be further used to study the the material structure under high & low temperature; Structure analysis of thin film samples, texture of metal materials, stress measurement, etc.

Within the most advanced technology at present, the accuracy of the goniometer had reached the current world advanced level. The X-ray source and detector can work stably for a long time to ensure the accuracy of measurement of diffraction peak position, peak shape and intensity. Phase structure analysis, including: phase content,

grain size judgment, crystallinity, austenite content, cell measurement, second class stress calculation, diffraction line indexing, phase structure analysis, thin film material analysis, small angle particle size analysis, etc.

DW-Y3500A XRD includes liquid X-ray generator, high-precision goniometer, scintillation detector, data processing software, and related application software.



Features

- **Stable X-ray generator** : Liquid X-ray generator;
- **Long life X-ray tube**: metal ceramic X-ray tube, with good heat dissipation, high operating power (40kV×40mA), long service life;
- **High precision goniometer**: It is controlled by optical coding technology. Based technology, incremental optical coding technology is adopted. The optical digital coding can directly read the angle from both arms (invention patent), which greatly improves the accuracy and repeatability of the goniometer. The new generation of direct optical coding systems ensures the accuracy of the goniometer over the life of the instrument through the accurately calibrated Heidenhain optical encoder and trajectory tracking technology.

The goniometer adopts “coaxial & different core” technology (invention patent) to avoid the interference between the arms during scanning, ensuring the accuracy and stability of the goniometer.

- **Multiple XRD accessories**: high temperature, low temperature, multi-function and other XRD accessories installation to achieve "plug and play", software automatic identification control technology, convenient for operators to use the instalment;
- **Safe X-ray protection**: X-ray scattering line protection device is more safe and reliable, the X-ray protection door is forbidden to open when the sample is measured, and double protection can avoid the operator from scattering line radiation under any circumstances.

Main parameters

1. X-ray generator (Liquid)

Max. output power : 4KW

Tube voltage : 10 ~ 60kV , 1kV/step

Tube current : 5 ~ 80mA , 1mA/step

Stability of voltage& current : $\leq 0.01\%$ (when the external voltage fluctuates 10%)

Water circulation cooling system is available.

Protections for over voltage, over current, over power, lack water are available.

X-ray tube: metal-body ceramic X-ray tube

Focus size: Focus $1 \times 10\text{mm}$

Standard target: Cu target (other target can be customized)

X-ray tube power: 2.4kW

2.High precision goniometer

Goniometer: vertical type, θ/θ , sample is placed horizontally

Using incremental coded reading technology

Diffraction circle radius: 180mm ~ 300mm

Scanning mode: continuous, step-by-step

2θ Measuring range: $-110^\circ \sim 168^\circ$

Minimum step Angle: 0.0001°

Maximum rotational speed: $20^\circ/\text{s}$

Diffraction Angle measurement linearity: $\leq 0.01^\circ$

Full spectrum Angle measurement accuracy: $\pm 0.005^\circ$

Beam size: $180 \times 180 \mu\text{m}$

Resolution: $\leq 0.028^\circ$ (2θ center)

Repeatability error: $\pm 0.0001^\circ$

Angle reproducibility: 0.0001°

Maximum positioning speed: $\leq 1200^\circ/\text{min}$

Diffraction angular linearity: the angular deviation of all peaks in the full spectrum does not exceed $\pm 0.01^\circ$.

3.Detector

Scintillation detector :

With a monochromator, it can effectively remove the $K\beta$ line,

Maximum linear count: $\geq 5 \times 10^5 \text{CPS}$,

Spectral resolution : $\leq 50\%$.

Curved crystal graphite monochromator:

When testing the sample, a monochromator is required to effectively remove the $K\beta$ line,

and the reflection efficiency is $\geq 28\%$.

4.control and data processing software

Computer: control and data processing software running under the Windows10 operating system.

Application software:

Phase qualitative, quantitative analysis, $K\alpha_1$, α_2 stripping, full spectrum fitting, peak selection fitting, half-height width and grain size calculation, cell measurement, secondary stress calculation, diffraction line index, multiple plotting, 3D plotting, diffraction data calibration, background deduction, quantitative analysis without standard sample, full spectrum fitting (WPF), XRD diffraction pattern simulation.

Overall dimensions of XRD host

1320×1150×1860mm

Working condition

1. Working temperature: 10°C ~ 30°C.
2. Ambient relative humidity: ≤80%.
3. Power supply: unidirectional, AC 220V, 50HZ, power supply voltage fluctuation does not exceed the rated voltage -10% ~ +10%, power capacity is not less than 5kVA.
4. There should be a good grounding device, grounding resistance is not more than 4Ω.
5. Cooling system: Independent self-circulating refrigeration system, using pure water.
6. The power supply line shall not have arc and high-frequency interference caused by welding machines, high-frequency furnaces and other equipment.
7. The surrounding environment should not have flammable and corrosive gases, and try to avoid dust and vibration.

Protection system

The protection system is safe and reliable, with machine and door interlocking mechanism. When operator open the door, at the same time the shutter stops working. This function can avoid the operator from being exposed to scattered ray radiation.

The radiation dose < 0.2μSv/h.

Configuration list (Model : DW-Y3500A)

Part	Name	Unit	Qty	Remark
X-ray generator	High frequency high voltage solid X-ray generator	Set	1	Liquid oil state
	XD3560 High voltage cable (100kVP)	Piece	1	Length : 3m
	XD3510 Tube sleeve (includes auto-shutter)	Set	1	
	XD3520 Auto-control unit	Set	1	power cable 1 piece
	XD3530 Cabinet	Set	1	Lead+ lead glass
	AL3540 Metal ceramic insulated X-ray tube	Piece	1	Cu target 2.4kW
Goniometer	XD3502 goniometer (θ-θ structure)	Set	1	
	Slit, powder sample stage	Set	1	1 set for each
	Through hole sample holder	Piece	10	Quartz matrix
	Blind hole sample holder	Piece	30	Quartz matrix
	filter	Piece	1	Match with the target
	X-ray path adjustment accessories	Set	1	
Record control unit	Scintillation detector	Set	1	
	Recorder-controller	Set	1	
	Electrical machinery& communication cable	Set	1	2 motor cables, 1 communication cable
	Power system	Set	1	
Cooling system	AL3 Circulating water cooling system	Set	1	unibody construction
	Cooling water connection pipe	Piece	2	
PC	Intel i Series processor, 8G memory, 256G SSD, 24-inch LED display	Set	1	Dell
	A4 laser printer	Set	1	
Control& application software	DWseries XRD control software	Set	1	Windows11
	XRD data processing software	Set	1	
	Diffraction data card base	Set	1	
	Crystal Structure Data Base	Set	1	
Documents	User Manual	Copy	1	
	Water cooling system instruction	Copy	1	
Spare parts	Fuse 1、 2、 3、 5、 10 (A)	Piece	10	10 for each
	Tool	Set	1	
	Agate mortar Φ100	Set	1	
	Graphite monochromator	Set	1	Reflectivity >28%

Technical Solution of X-ray Diffractometer

(Model:DW-Y3500B)

Basic description

The new high-end X-ray diffractometer (XRD) is domestic high-performance and high-precision XRD, which is the project of the National Development and Reform Commission. With advanced core technology, it can accurately do qualitative and quantitative phase analysis of metal and non-metallic polycrystalline samples. It can be mainly used in qualitative or quantitative analysis, crystal structure analysis, material structure analysis, macroscopic or microscopic stress determination, crystal size determination, crystallinity determination, etc., therefore, It is widely used in many disciplines and industries: materials science, physics, chemistry, chemical industry, metallurgy, minerals, drugs, building materials, ceramics, etc.

Base on this standard configuration, if we install related accessories, it can do analysis structure of thin films, texture of metal materials, stress measurement, and material structure under high and low temperature.

Within the most advanced technology at present, the accuracy of the goniometer had reached the current world advanced level.

The X-ray source and detector can work stably for a long time to ensure the accuracy of measurement of diffraction peak position, peak shape and intensity. Phase structure analysis, including: phase content, grain size judgment, crystallinity, austenite content, cell measurement, second class stress calculation, diffraction line indexing, phase structure analysis, thin film material analysis, small angle particle size analysis, etc.

DW-Y3500B XRD includes High frequency high voltage solid X-ray generator, high-precision goniometer, scintillation detector, data processing software, and related application software.



Features

- **High-frequency and high-voltage X-ray source:** Solid X-ray generator greatly improves the stability of the measurement results of the XRD;
- **Long life X-ray tube:** metal ceramic X-ray tube, with good heat dissipation, high operating power (40kV×40mA), long service life;
- **High precision goniometer:** It is controlled by optical coding technology. Based on the traditional turboworm transmission technology, incremental optical coding technology is adopted. The optical digital coding can directly read the angle from both arms (invention patent), which greatly improves the accuracy and repeatability of the goniometer. The new generation of direct optical coding systems ensures the accuracy of the goniometer over the life of the instrument through the accurately calibrated Heidenhain optical encoder and trajectory tracking technology.
The goniometer adopts “coaxial & different core” technology (invention patent) to avoid the interference between the arms during scanning, ensuring the accuracy and stability of the goniometer.
- **Multiple XRD accessories:** high temperature, low temperature, multi-function and other XRD accessories installation to achieve "plug and play", software automatic identification control technology, convenient for operators to use the instrument;
- **Safe X-ray protection:** X-ray scattering line protection device is more safe and reliable, the X-ray protection door is forbidden to open when the sample is measured, and double protection can avoid the operator from scattering line radiation under any circumstances.

Main parameters

1. High frequency high voltage solid X-ray generator

Maximum output power: 3kW

Tube voltage: 10 ~ 50KV, 1kV/step

Tube current: 5 ~ 60mA, 1mA/step

Stability of voltage& current: $\leq 0.005\%$ (when the external voltage fluctuates 10%)

Water circulation cooling system is available.

Protections for over voltage, over current, over power, lack water are available.

X-ray tube: metal-body ceramic X-ray tube

Focus size: Focus 1×10 mm

Standard target: Cu target (other target can be customized)

X-ray tube power: 2.4kW

2. High precision goniometer

Goniometer: vertical type, θ/θ , sample is placed horizontally

Using incremental coded reading technology

Diffraction circle radius: 180mm ~ 300mm

Scanning mode: continuous, step-by-step

2θ Measuring range: $-110^\circ \sim 168^\circ$

Minimum step Angle: 0.0001°

Maximum rotational speed: $20^\circ/\text{s}$

Diffraction Angle measurement linearity: $\leq 0.01^\circ$

Full spectrum Angle measurement accuracy: $\pm 0.005^\circ$

Beam size: $180 \times 180 \mu\text{m}$

Resolution: $\leq 0.028^\circ$ (2θ center)

Repeatability error: $\pm 0.0001^\circ$

Angle reproducibility: 0.0001°

Maximum positioning speed: $\leq 1200^\circ/\text{min}$

Diffraction angular linearity: the angular deviation of all peaks in the full spectrum does not exceed $\pm 0.01^\circ$.

3. Detector

Scintillation detector:

It Works with monochromator to effectively remove the $K\beta$ line,

Maximum linear count: $\geq 5 \times 10^5 \text{CPS}$,

Spectral resolution: $\leq 50\%$.

Curved crystal graphite monochromator:

When testing the sample, a monochromator is required to effectively remove the $K\beta$ line,

and the reflection efficiency is $\geq 28\%$.

4. Control and data processing software

Computer: control and data processing software running under the Windows10 operating system.

Application software:

Phase qualitative, quantitative analysis, $K\alpha_1$, α_2 stripping, full spectrum fitting, peak selection fitting, half-height width and grain size calculation, cell measurement, secondary stress calculation, diffraction line index, multiple plotting, 3D plotting, diffraction data calibration, background deduction, quantitative analysis without standard sample, full spectrum fitting (WPF), XRD diffraction pattern simulation.

Overall dimensions of XRD host

1320×1150×1860mm

Working condition

1. Working temperature: 10°C ~ 30°C.
2. Ambient relative humidity: ≤80%.
3. Power supply: unidirectional, AC 220V, 50HZ, power supply voltage fluctuation does not exceed the rated voltage -10% ~ +10%, power capacity is not less than 5kVA.
4. There should be a good grounding device, grounding resistance is not more than 4Ω.
5. Cooling system: Independent self-circulating refrigeration system, using pure water.
6. The power supply line shall not have arc and high-frequency interference caused by welding machines, high-frequency furnaces and other equipment.
7. The surrounding environment should not have flammable and corrosive gases, and try to avoid dust and vibration.

Protection system

The protection system is safe and reliable, with machine and door interlocking mechanism. When operator open the door, at the same time the shutter stops working. This function can avoid the operator from being exposed to scattered ray radiation. The radiation dose < 0.2μSv/h.

Configuration list (Model : DW-Y3500B)

Part	Name	Unit	Qty	Remark
X-ray generator	High frequency high voltage solid X-ray generator	Set	1	Liquid oil state
	XD3560 High voltage cable (100kVP)	Piece	1	Length: 3m
	XD3510 Tube sleeve (includes auto-shutter)	Set	1	
	XD3520 Auto-control unit	Set	1	power cable 1 piece
	XD3530 Cabinet	Set	1	Lead+ lead glass
	AL3540 Metal ceramic insulated X-ray tube	Piece	1	Cu target 2.4kW
Goniometer	XD3502 goniometer (θ-θ structure)	Set	1	
	Slit, powder sample stage	Set	1	1 set for each
	Through hole sample holder	Piece	10	Quartz matrix
	Blind hole sample holder	Piece	30	Quartz matrix
	filter	Piece	1	Match with the target
	X-ray path adjustment accessories	Set	1	
Record control unit	Scintillation detector	Set	1	
	Recorder-controller	Set	1	
	Electrical machinery& communication cable	Set	1	2 motor cables, 1 communication cable
	Power system	Set	1	
Cooling system	AL3 Circulating water cooling system	Set	1	unibody construction
	Cooling water connection pipe	Piece	2	
PC	Intel i Series processor, 8G memory, 256G SSD, 24-inch LED display	Set	1	Dell
	A4 laser printer	Set	1	
Control& application software	DWseries XRD control software	Set	1	Windows11
	XRD data processing software	Set	1	
	Diffraction data card base	Set	1	
	Crystal Structure Data Base	Set	1	
Documents	User Manual	Copy	1	
	Water cooling system instruction	Copy	1	
Spare parts	Fuse 1、 2、 3、 5、 10 (A)	Piece	10	10 for each
	Tool	Set	1	
	Agate mortar Φ100	Set	1	
	Graphite monochromator	Set	1	Reflectivity > 28%

Technical Solution of X-ray Diffractometer

(Model: DW-Y3500C)

Basic description

The new high-end X-ray diffractometer (XRD) is domestic high-performance and high-precision XRD, which is the project of the National Development and Reform Commission. With advanced core technology, it can accurately do qualitative and quantitative phase analysis of metal and non-metallic polycrystalline samples. It can be mainly used in qualitative or quantitative analysis, crystal structure analysis, material structure analysis, macroscopic or microscopic stress determination, crystal size determination, crystal size determination, crystallinity determination, etc., therefore, It is widely used in many disciplines and industries: materials science, physics, chemistry, chemical industry, metallurgy, minerals, drugs, building materials, ceramics, etc.

Base on this standard configuration, if we install related accessories, it can do analysis structure of thin films, texture of metal materials, stress measurement, and material structure under high and low temperature.

Within the most advanced technology at present, the accuracy of the goniometer had reached the current world advanced level.

The X-ray source and detector can work stably for a long time to ensure the accuracy of measurement of diffraction peak position, peak shape and intensity. Phase structure analysis, including: phase content, grain size judgment, crystallinity, austenite content, cell measurement, second class stress calculation, diffraction line indexing, phase structure analysis, thin film material analysis, small angle particle size analysis, etc.

DW-Y3500C XRD includes High Frequency & High Voltage Solid X-ray generator, high-precision goniometer, 1 D semiconductor array detector, data processing software, and related application software.



Features

- **High-frequency and high-voltage X-ray source:** Solid X-ray generator greatly improves the stability of the measurement results of the XRD;
- **Long life X-ray tube:** metal ceramic X-ray tube, with good heat dissipation, high operating power (40kV×40mA), long service life;
- **High precision goniometer:** It is controlled by optical coding technology. Based on the traditional turboworm transmission technology, incremental optical coding technology is adopted. The optical digital coding can directly read the angle from both arms (invention patent), which greatly improves the accuracy and repeatability of the goniometer. The new generation of direct optical coding systems ensures the accuracy of the goniometer over the life of the instrument through the accurately calibrated Heidenhain optical encoder and trajectory tracking technology.
The goniometer adopts “coaxial & different core” technology (invention patent) to avoid the interference between the arms during scanning, ensuring the accuracy and stability of the goniometer.
- **Multiple XRD accessories:** high temperature, low temperature, multi-function and other XRD accessories installation to achieve "plug and play", software automatic identification control technology, convenient for operators to use the instrument;
- **Safe X-ray protection:** X-ray scattering line protection device is more safe and reliable, the X-ray protection door is forbidden to open when the sample is measured, and double protection can avoid the operator from scattering line radiation under any circumstances.

Main parameters

1. High frequency high voltage solid X-ray generator

Maximum output power: 3kW

Tube voltage: 10 ~ 50KV, 1kV/step

Tube current: 5 ~ 60mA, 1mA/step

Stability of current and voltage : $\leq \pm 0.005\%$ (when the external voltage fluctuates 10%)

X-ray tube: metal-body ceramic X-ray tube

Focus size: Focus 1×10mm

Standard target: Cu target (other target can be customized)

X ray tube power: 2.4kW

2. High precision goniometer

Goniometer: vertical type, θ/θ , sample is placed horizontally

Using incremental coded reading technology

Diffraction circle radius: 180mm ~ 300mm

Scanning mode: continuous, step-by-step

2 θ Measuring range: $-110^\circ \sim 168^\circ$

Minimum step Angle: 0.0001°

Maximum rotational speed: $20^\circ/\text{s}$

Diffraction Angle measurement linearity: $\leq 0.01^\circ$

Full spectrum Angle measurement accuracy: $\pm 0.005^\circ$

Beam size: $180 \times 180 \mu\text{m}$

Resolution: $\leq 0.028^\circ$ (2 θ center)

Repeatability error: $\pm 0.0001^\circ$

Angle reproducibility: 0.0001°

Maximum positioning speed: $\leq 1200^\circ/\text{min}$

Diffraction angular linearity: the angular deviation of all peaks in the full spectrum does not exceed $\pm 0.01^\circ$.

3. Detector

1 D semiconductor array detector:

- Data acquisition, stepping and continuous measurement types are consistent.
- Good data quality, providing undistorted scanning data without any broken lines.
- It can be used for ultrafast scanning of powders, for measurements using reflection (Bragg-Brentano) or transmission diffraction geometry, and for reciprocal spatial mapping of epitaxial films.
- Maximum linear count: $\geq 9 \times 10^9 \text{CPS}$
- Maximum linear count: $\leq 25\%$
- High count mode and fluorescent background removal mode are available

Curved crystal graphite monochromator:

When testing the sample, a monochromator is required to effectively remove the $K\beta$ line, and the reflection efficiency is $\geq 28\%$.

4. control and data processing software

Computer: control and data processing software running under the Windows10 operating system.

Application software:

Phase qualitative, quantitative analysis, $K\alpha_1$, α_2 stripping, full spectrum fitting, peak selection fitting, half-height width and grain size calculation, cell measurement, secondary stress calculation, diffraction line index, multiple plotting, 3D plotting, diffraction data calibration, background deduction, quantitative analysis without standard sample, full spectrum fitting (WPF), XRD diffraction pattern simulation.

Overall dimensions of XRD host

1320×1150×1860mm

Working condition

1. Working temperature: 10°C ~ 30°C.
2. Ambient relative humidity: ≤80%.
3. Power supply: unidirectional, AC 220V, 50HZ, power supply voltage fluctuation does not exceed the rated voltage -10% ~ +10%, power capacity is not less than 5kVA.
4. There should be a good grounding device, grounding resistance is not more than 4Ω.
5. Cooling system: Independent self-circulating refrigeration system, using pure water.
6. The power supply line shall not have arc and high-frequency interference caused by welding machines, high-frequency furnaces and other equipment.
7. The surrounding environment should not have flammable and corrosive gases, and try to avoid dust and vibration.

Protection system

The protection system is safe and reliable, with machine and door interlocking mechanism. When operator open the door, at the same time the shutter stops working. This function can avoid the operator from being exposed to scattered ray radiation.

The radiation dose < 0.2μSv/h.

Configuration list (Model: DW-Y3500C)

Part	Name	Unit	Qty	Remark
X-ray generator	High-frequency high voltage generator	Set	1	solid state
	XD3560 High voltage cable (100kVP)	Piece	1	Length: 3m
	XD3510 Tube sleeve (includes auto-shutter)	Set	1	
	XD3520 Auto-control unit	Set	1	power cable 1 piece
	XD3530 Cabinet	Set	1	Lead+ lead glass
	AL3540 Metal ceramic insulated X-ray tube	Piece	1	Cu target 2.4kW
Goniometer	XD3502 goniometer (θ-θ structure)	Set	1	
	Slit, powder sample stage	Set	1	1 set for each
	Through hole sample holder	Piece	10	Quartz matrix
	Blind hole sample holder	Piece	30	Quartz matrix
	filter	Piece	1	Match with the target
	X-ray path adjustment accessories	Set	1	
Record control unit	1D Semiconductor array detector	Set	1	
	Recorder-controller	Set	1	
	Electrical machinery& communication cable	Set	1	2 motor cables, 1 communication cable
	Power system	Set	1	
Cooling system	AL3 Circulating water cooling system	Set	1	unibody construction
	Cooling water connection pipe	Piece	2	
PC	Intel i Series processor, 8G memory, 256G SSD, 24-inch LED display	Set	1	Dell
	A4 laser printer	Set	1	
Control& application software	DWseries XRD control software	Set	1	Windows11
	XRD data processing software	Set	1	
	Diffraction data card base	Set	1	
	Crystal Structure Data Base	Set	1	
Documents	User Manual	Copy	1	
	Water cooling system instruction	Copy	1	
Spare parts	Fuse 1、 2、 3、 5、 10 (A)	Piece	10	10 for each
	Tool	Set	1	
	Agate mortar Φ100	Set	1	
	Graphite monochromator	Set	1	Reflectivity > 28%