

**MiniFlex 600**  
**High quality data from**  
**Benchtop XRD**

# XRD instrumentation together with XRF

- XRD instrumentation is a practical tool to have together with XRF as information from the techniques help
- Complementary information – distinguish different phases with identical chemical composition (e.g. Aragonite / Calcite, Rutile / Brookite / Anatase)

# The Rigaku MiniFlex





# Analysis software PDXL 2 - one program for all applications

- Phase ID
- Phase quantification (RIR / standard methods)
- Crystallinity
- Indexing
- Structure determination
- Strain/stress analysis
- Rietveld refinement

# PDXL 2 - one program for all applications

Intensity (cps)

2-theta (deg)

← Show  $K\beta$ ,  $K\alpha_{1,2}$  lines

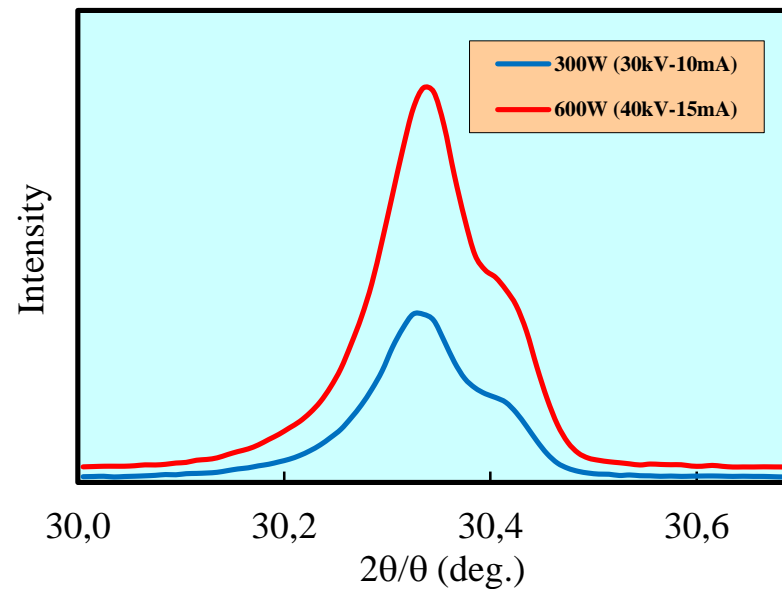
Phases

No.	2-theta (deg)	d (ang.)	Height (cps)	FWHM (deg)	Int. I (cps deg)	Int. W (deg)	Size (ang.)	Phase name	Rel. int. I (a.u.)	Rel. height	F
1	20.897(2)	4.2475(4)	176968(1214)	0.094(3)	25607(381)	0.145(3)	902(27)	Quartz(1 0 0)	18.60	20.61	Split
2	24.076(8)	3.6934(11)	5701(218)	0.105(13)	935(32)	0.164(12)	809(100)	Unknown	0.68	0.66	Split
3	26.703(4)	3.3357(4)	85859(2675)	0.123(4)	137681(1684)	0.160(2)	691(20)	Quartz(0 1 1)	100.00	100.00	Split
4	36.6021(12)	2.45310(8)	64993(736)	0.1124(13)	9429(51)	0.145(2)	777(9)	Quartz(1 1 0)	6.85	7.57	Split
5	39.5240(16)	2.27822(9)	55571(681)	0.1135(16)	7890(62)	0.142(3)	777(11)	Quartz(1 0 2)	5.73	6.47	Split
6	40.3463(12)	2.23366(7)	33529(529)	0.1093(13)	4620(31)	0.138(3)	808(10)	Quartz(1 1 1)	3.36	3.91	Split
7	42.5077(12)	2.12495(6)	44178(607)	0.1172(12)	6661(36)	0.151(3)	760(8)	Quartz(2 0 0)	4.84	5.15	Split
8	45.8454(14)	1.97771(6)	32468(520)	0.1083(14)	4684(32)	0.144(3)	832(11)	Quartz(2 0 1)	3.40	3.78	Split
9	50.1944(8)	1.81607(3)	109076(953)	0.1141(7)	16219(59)	0.1487(18)	803(5)	Quartz(1 1 2)	11.78	12.70	Split
10	50.657(10)	1.8006(3)	1870(125)	0.142(15)	347(22)	0.19(2)	645(70)	Quartz(0 0 3)	0.25	0.22	Split
11	54.9264(12)	1.67028(3)	38083(563)	0.1099(10)	5520(31)	0.145(3)	851(8)	Quartz(0 2 2)	4.01	4.44	Split
12	55.3797(17)	1.65767(5)	12699(325)	0.115(2)	1924(21)	0.151(6)	816(14)	Quartz(0 1 3)	1.40	1.48	Split

# The Rigaku MiniFlex

## *More Power*

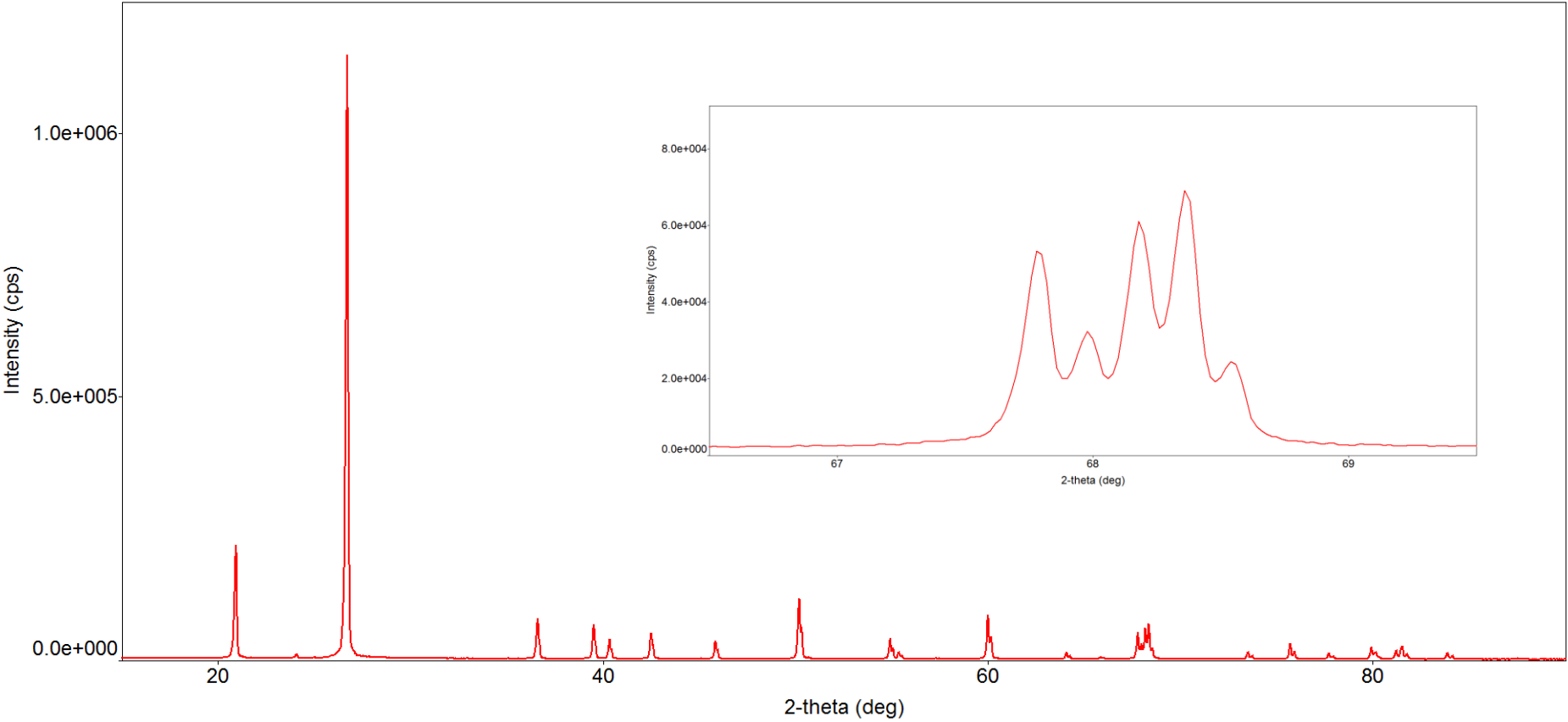
The world's largest **600W** X-ray source generates more X-ray photons.  
More “faster” & “reliable”



# The Rigaku MiniFlex

*More Power*

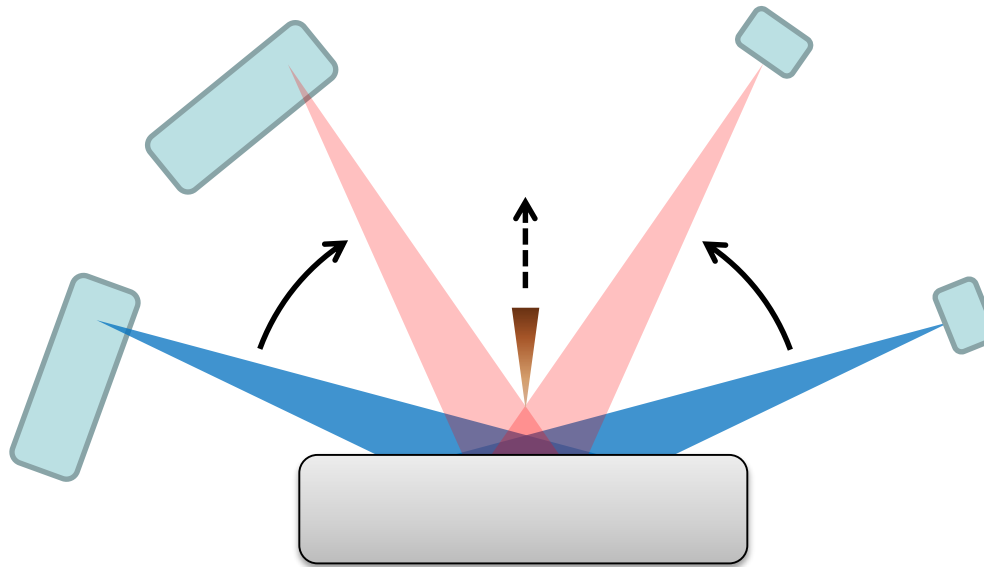
Quartz sample, 10° / minute





# The Rigaku MiniFlex

## *Variable knife edge*



### **Knife edge**

- ✓ Knife edge is used with 1D detector to suppress air-scatter.
- ✓ Optimum height of KE from sample surface depends on  $\theta$  angle.

# The Rigaku MiniFlex

## *Variable knife edge*



### Curved com

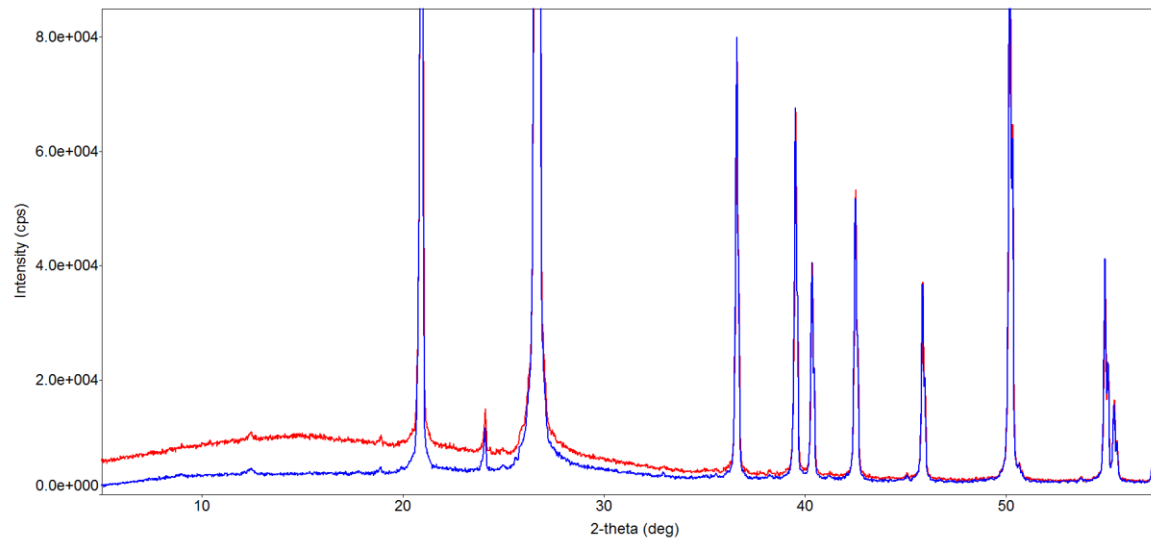
Curvature is created so that the com push up the knife-edge as  $\theta$  angle becomes high.



# The Rigaku MiniFlex

## *Variable knife edge*

- ✓ Reduce air-scatter at low angle
- ✓ Improve low  $2\theta$  angle accessibility
- ✓ No blind creation at high  $2\theta$  angle ( $>130^\circ$  )



# The Rigaku MiniFlex

## *More Flexibility:* Detector



**Scintillation counter**

Low cost of ownership  
Conventional detector

Speed: 1  
S/N ratio: 1



**D/teX Ultra2 1D strip**

Fast measurement for  
high throughput  
measurement

Speed: 100  
S/N ratio: 1



**D/teX Ultra2 1D strip XRF**

Fast measurement with  
XRF suppression mode

Speed: 50  
S/N ratio: 5



**Scintillation counter with CM**

Ultimate XRF  
suppression by counter  
monochromator (CM)

Speed: 0.5  
S/N ratio: 10

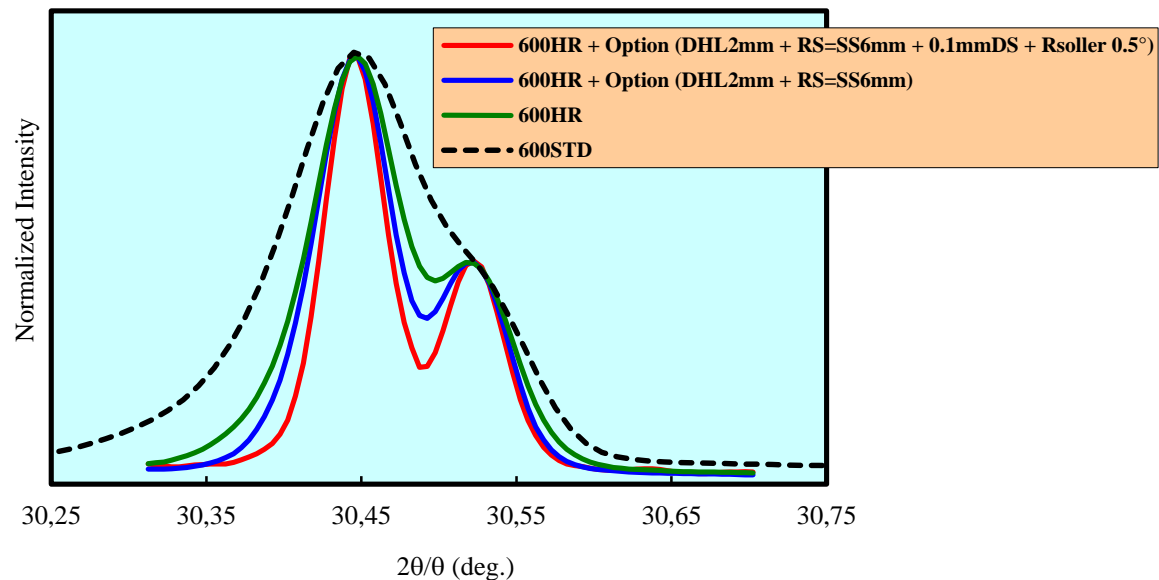
# The Rigaku MiniFlex

## *More Flexibility:* Resolution

✓ High-resolution mode

✓ High-intensity mode

can be switched depending on sample / measurement

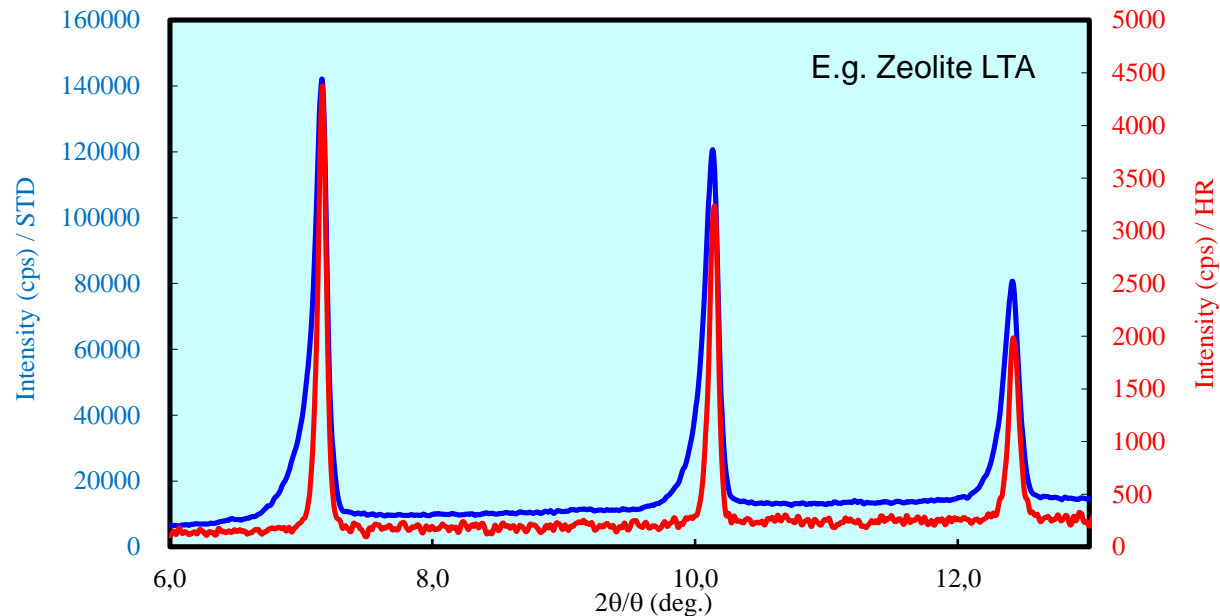


# The Rigaku MiniFlex

## *More Flexibility:* Resolution

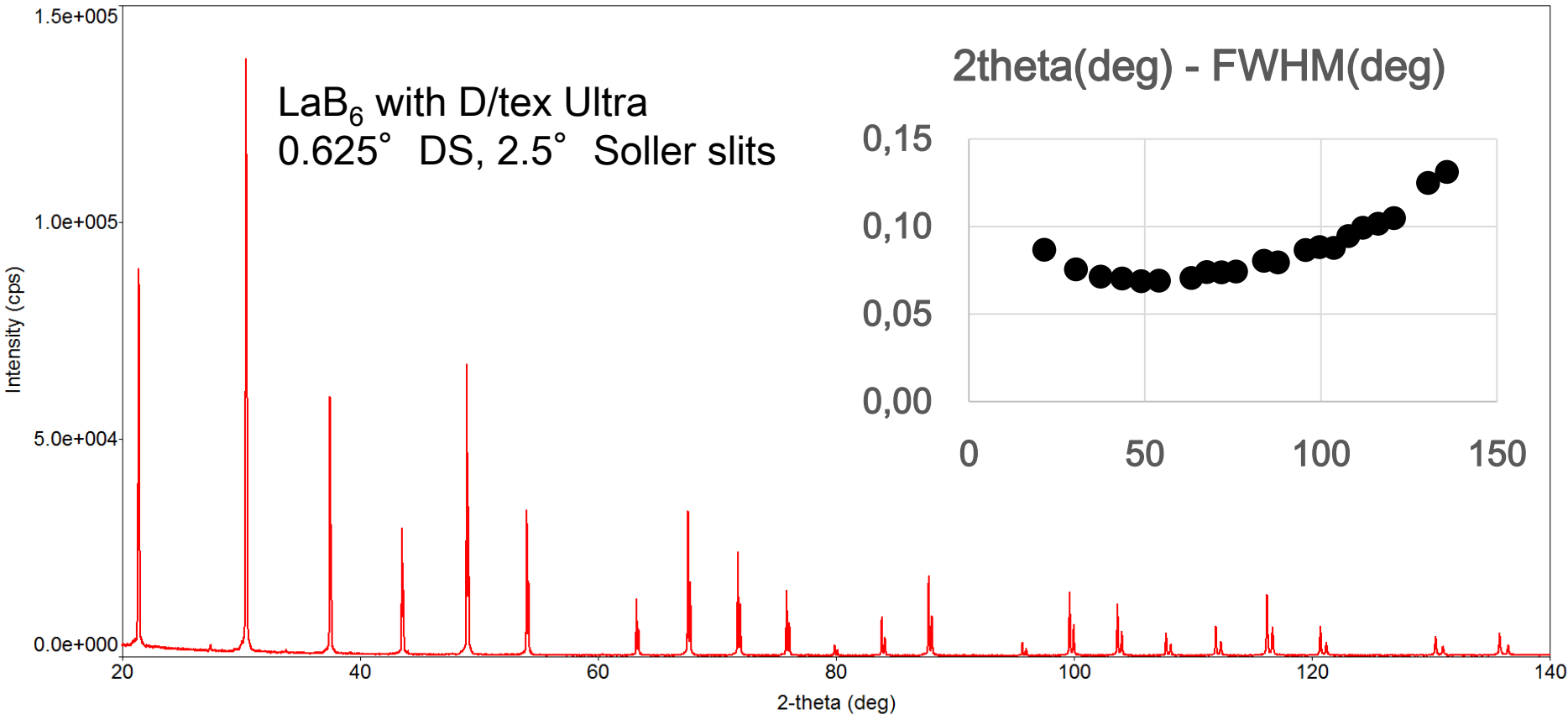
### High-resolution mode

- ✓ Better peak separation
- ✓ Better peak profile at lower  $2\theta$  angle



# The Rigaku MiniFlex

## Resolution: FWHM



# The Rigaku MiniFlex

## *More Results*

- ✓ Automated 6-sample changer
- ✓ Air-tight sample holder

### Automated sample changer

ASC-6 Automatic 6-position sample changer with spinner



### Air-sensitive sample holder

An air-sensitive sample holder is available for users studying materials that might degrade in the presence of air.



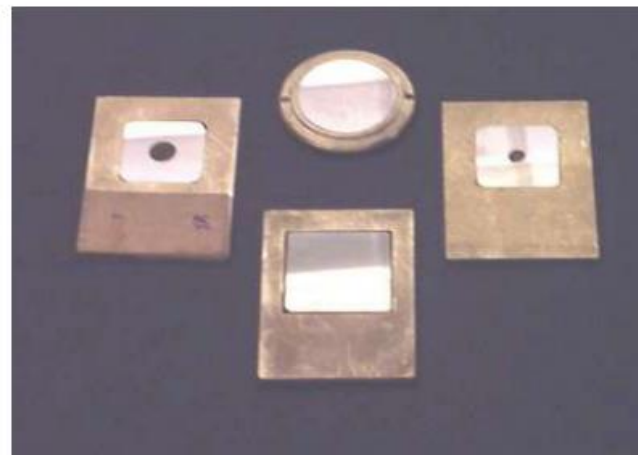
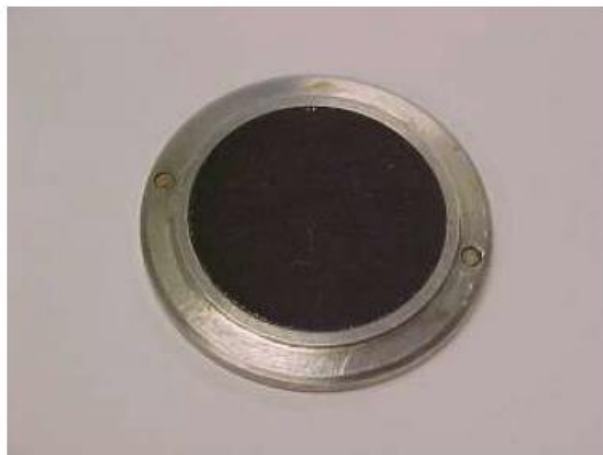


# The Rigaku MiniFlex

## *More Results*

✓Zero-background sample holder

Used for small sample amounts or in order to minimize transparency effects with weakly absorbing samples



# Application

- **Phase identification**
- **Quantitative analysis**
  - ✓ Internal / external standard / standard addition method
  - ✓ RIR
  - ✓ Rietveld refinement
- **Crystallinity**
  - ✓ Amorphous content: pharmaceutical, slag
- **Crystallite size and strain**
  - ✓ Scherrer's method
  - ✓ crystallite size distribution
- **Lattice parameters refinement**
  - ✓ WPPF
  - ✓ Rietveld refinement
- **Rietveld refinement for structural characterization**
  - ✓ Ab-initio structure determination