

X-ray diffraction

Structural studies of pharmaceutical products using the ARL EQUINOX 100 X-ray benchtop Diffractometer

Introduction

X-ray diffraction is the gold standard of techniques used in the structural and phase characterization of pharmaceutical products. XRD is one of the most commonly used techniques in the pipeline from drug discovery to preformulation and formulation, through to stability and quality control. XRD has applications in studying the solid dosage forms, crystallinity and bioavailability of APIs.

In particular, XRD is routinely applied in the study of polymorphs, salts and co-crystals of a particular API. In addition XRD is also used to follow the crystallization of the product, for the determination of the crystalline percentage of the final product, the stability of the formulations and their reactivity in a controlled environment.

Depending on the scope of applications and the extent of measurements needed, different types of XRD instruments and configurations are used. For example, a bench-top XRD instrument would be the most cost effective solution for initial polymorph and salt screening, in QA/QC laboratories, and in determining the percentage of crystallinity of a substance. While a stand-alone high resolution XRD, more expensive, would be needed for more extensive research studies of the pharmaceutical product.

One of the most desirable features of the ARL EQUINOX 100 XRD benchtop system is its unique curved position sensitive (CPS) detector, enabling acquisition over a full range of 2θ (110° , 2θ) in real time to study the structural and crystallographic changes of the API and related products. Very fast measurements can be performed on the same sample as a function of different parameters enabling the analyst to make quicker decisions and/or process more samples.

Instrument

Thermo Scientific™ ARL™ EQUINOX 100 is a benchtop XRD instrument simple and easy to use for QA/QC, routine and academic analysis for investigations at various temperatures.

The ARL EQUINOX 100 uses a custom-designed 60 W micro X-Ray source with micro-focus X-Ray tube (Cu or Co) which does not require an external water chiller. The same unit can be



Figure 1. ARL EQUINOX 100 benchtop XRD instrument.

transported between laboratories or into the field and does not require any special infrastructure. There are also options available on the ARL EQUINOX 100 to study the reactivity and stability using a controlled environment cell. Both transmission and reflection mode measurements can be done on the same bench-top instrument.

The ARL EQUINOX 100 provides very fast data collection times compared to other diffractometers due to their unique curved position sensitive detector (CPS) that measures all diffraction peaks simultaneously and in real time.

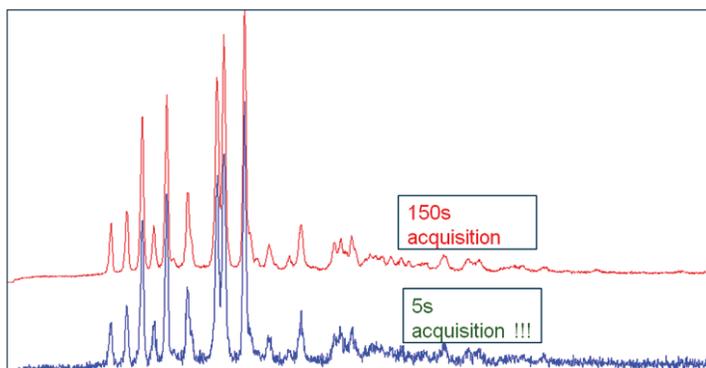


Figure 2. Paracetamol 250 mg measured in reflection mode 40 kV / 1 mA, scan from 2° to 100°.

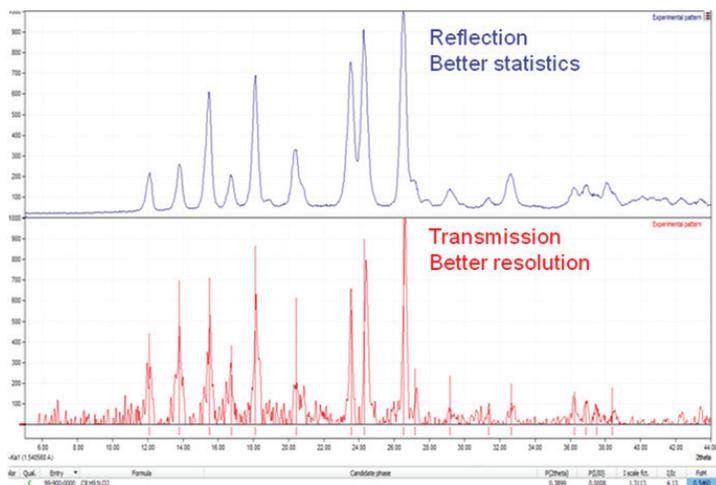


Figure 3. Paracetamol - comparison of analysis mode (reflection versus transmission).

Software, data processing and 21CFR Part 11 ready

The ARL EQUINOX 100 comes with a fully integrated data acquisition and processing software and can also interface with third party programs depending on the information to be obtained.

Moreover, in the need to meet the requirements of the Food and Drug Administration's Code of Federal Regulations Title 21, Part 11 Electronic Records / Electronic Signatures rule, Thermo Scientific™ SolstiXTM Software with Security Suite Software provides maximum security and data integrity assurance for the varying analytical needs of your laboratory.

In addition to standard XRD measurements under ambient conditions, ARL EQUINOX 100 can be fitted with optional sample stages (Figure 3) such as capillary stage, controlled atmosphere cell, transmission stage and sample spinners which provide lot more flexibility. Some of these options are unique to ARL EQUINOX 100 and are generally not available with other bench-top XRD instruments.

Figure 4. Standard sample holders.

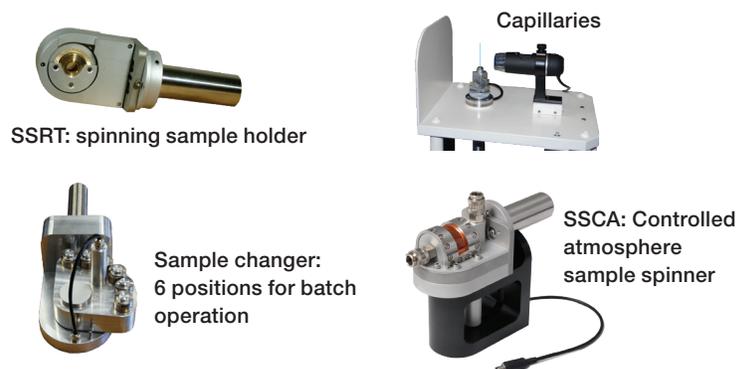
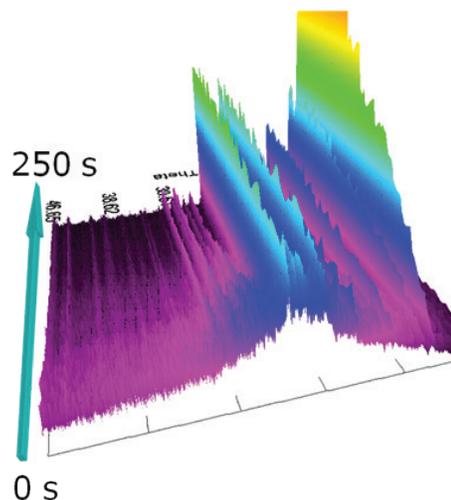


Figure 5. Crystallization of pharmaceutical product: real-time dynamic studies.



Conclusion

The ARL EQUINOX 100 is a fast, convenient and high performance X-ray diffraction instrument perfectly suited for routine applications in pharmaceutical industry. Although these are bench-top designs, they can accommodate different sample stages to extend the measurements for different applications.

Thanks to the simultaneous acquisition of the full 2θ range, data can be generated and processed much faster than conventional XRD benchtop systems.