ISBN: 978-3-95450-207-3 doi:10.18429/JACoW-MEDSI2018-THPH18

A MULTI-SAMPLE HOLDER FOR THE MSPD BEAMLINE AT ALBA

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Abstract

At the high resolution powder diffraction end station of the Materials Science and Powder Diffraction (MSPD) beamline at ALBA Synchrotron, several samples are measured on a daily basis. Thus, an automatic sample exchanger is a great asset to the beamline, permitting a more efficient use of beam time. Even if a robot arm is the more suitable option for a sample exchanger device, in terms of cost, compactness and versatility MSPD needs another approach. ALBA engineering division has developed a multi-sample holder that allows the loading of up to eight samples and exchanging between them with a resolution of less than a micron. This new design consists of a customized and motorized linear stage that has been designed to fit into the present three-circles diffractometer, on top of the positioning stages, avoiding any possible collision with the Eulerian cradle. In addition, this new holder permits the use of different types of samples like capillaries in fast spinners, coin cell batteries and electrochemical cells. Finally, the system is compatible with the usual sample conditioning equipment on the end station such as the hot blower, cryostream, beamstop, chiller, etc.

DESIGN

The multi-sample holder consists of a customized and motorized linear stage (Fig. 1). The mechanism involves a ball screw and linear guides together actuated by a stepper motor. The ball screw presents low axial clearance (less than 5 µm) in order to assure good repeatability and the linear guides are slightly preloaded for stiffness purpose.

Due to space restriction on top of the positioning stages of the present three-circles diffractometer, the multi-sample holder has been designed to be as narrow as possible (up to 31.5 mm) in order to not shadow the Mythen and Multicrystal Analyser detectors (Fig. 2). Also the system has been designed to avoid any possible collision with the Eulerian cradle.

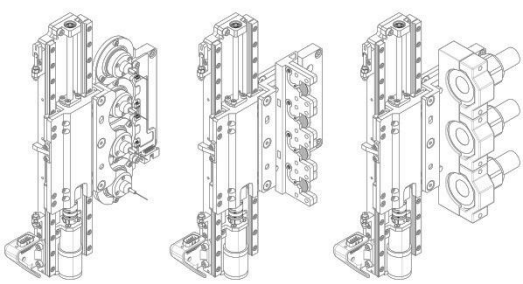

Figure 1: Multi sample holder in three configurations.

The multi sample holder permits the use of different types of samples like capillaries in fast spinners, coin cell batteries and electrochemical cells. For this purpose, a common interface is used for all sample holders, consisting of a plate with positioning pins and fixed by screws. This common interface will be compatible with all future sample developments in the beamline.

Finally, the complete system is suitable for sample conditioning equipment use on the end station such as the hot blower, cryostream, beamstop, chiller, etc. during normal operation.

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TECHNICAL SPECIFICATIONS

The multi sample holder complies with the following specifications:

- Linear resolution of 0.3 µm.
- Repeatability of 0.75 µm.
- Range of 166mm (±83 mm).
- Compact and integrated in the Eulerian cradle.
- Compatible with sample conditioning equipment.
- It provides 4 positions for coin cell batteries.
- It provides 3 positions for electrochemical cells.
- It provides 4 positions for fast spinners in its current design or 8 in a new configuration in development.

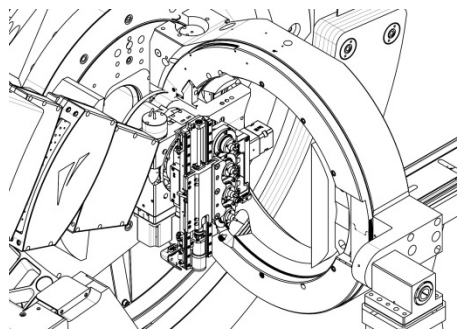

Figure 2: Multi sample holder on Eulerian cradle.

METROLOGY RESULTS

Metrology tests have been performed using a Renishaw ML10 Interferometer in order to evaluate the resolution, repeatability and other characteristics of the motion of the multi-sample holder in open loop.

Table 1: Metrology Results

Explored Range	0.156 m
Avg. resolution	0.1562 µm/hs
Backlash/Hysteresis	2.32 µm
Repeatability	0.75 µm
Linearity	4.39 µm
Sampling noise	18 nm

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The position error versus the motor position has been measured (Fig. 3), obtaining results in average resolution, hysteresis, repeatability and linearity (Table 1). Additionally, resolution tests in dynamic mode have been performed to test the mechanical response of the system to the minimum achievable step size.

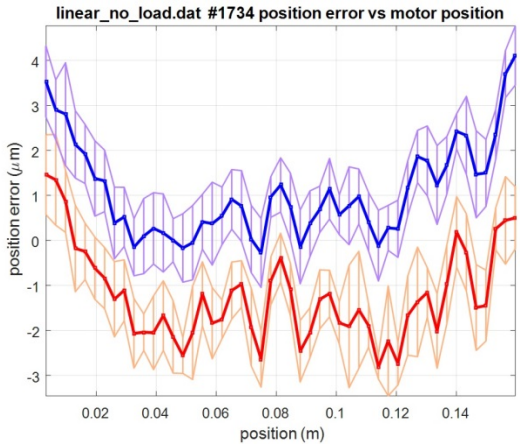

Figure 3: Position error vs motor position.

CONCLUSION

In conclusion, ALBA engineering division has developed the design of a multi-sample holder based in a linear stage mechanism that allows the loading of up to eight samples and exchanging between them with a resolution of less a micron, integrated in the high resolution powder diffraction end station.

This solution permits faster operation of the end station and a more efficient use of beam time in the MSPD beamline.

ACKNOWLEDGEMENT

The authors wish to acknowledge all those most involved in the design, construction and test: Mechanical Engineers, Llibert Ribó and Edmundo Fraga; Mechanical Workshop, Jordi Navarro and José Ferrer; Electronics Section, Sergio Astorga; Optics, Development & Innovation Section, P. de la Rubia and Josep Nicolàs.