A Complete, Versatile, And Cost-Effective Solution for Routine Serial And "Conventional" Synchrotron Crystallography

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Serial synchrotron crystallography (SSX) enables use of small crystals for structure–function studies of biomolecules and for drug discovery. Many SSX approaches require large numbers of crystals having similar (small) size and shape, and allow data collection from only a fraction of available crystals. However, crystals of non-model proteins generated in crystallization trials are typically modest in number and heterogeneous in size and shape. Despite some striking successes and impressive technical achievements, the impact of serial crystallographic methods on general practice has so far been limited. An integrated SSX system has been developed with the goal of getting all available crystals – from 1 to 10^5 – into the X-ray beam with the least effort and in the best possible condition. The system consists of ultra-low background-scatter large area sample holders suitable for room and cryogenic temperature data collection and a humidified sample- loading workstation.
The sample holders incorporate thin-film supports with a variety of designs optimized for different crystal-loading challenges. These holders facilitate dispersion of crystals across the support and removal of excess liquid, can be cooled at extremely high rates, generate little background scatter, allow data collection over >90° of oscillation without obstruction or risk of generating saturating Bragg peaks, are resusable, and are compatible with existing infrastructure for high-throughput cryocrystallography.
The sample-loading workstation allows sample preparation and loading onto the support film; application of time-varying suction for optimal removal of excess liquid, for crystal repositioning and for crystal cryoprotection; and application of sealing films for room-temperature data collection. The workstation provides a near saturating humidity (>95% r.h.) environment, eliminating dehydration of even the smallest crystals and drying of open crystallization drops, while allowing observation of all operations via a microscope. This integrated system addresses common problems in obtaining properly dispersed, properly hydrated and isomorphous microcrystals for fixed-orientation and oscillation data collection. Its ease of use, flexibility, and optimized performance make it attractive not just for SSX but also for single-crystal and few-crystal data collection.

Refernces
[1] G. Illava, R. Jayne, A. D. Finke, D. Closs, W. Zeng, S. K. Milano, Q. Huang, I. Kriksunov, P. Sidorenko, F. W. Wise, W. R. Zipfel, B. A. Apker, and R. E. Thorne, Acta Cryst. D77, 628-644 (2021).

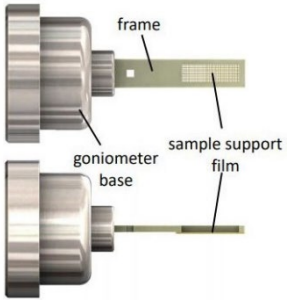

Figure 1

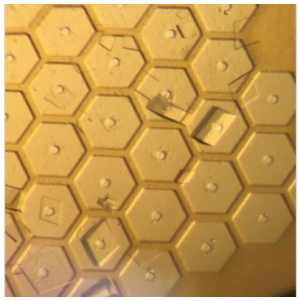

Figure 2

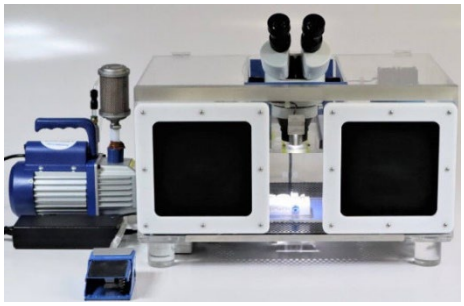

Figure 3