European XFEL Workshop

Opportunities for microfluidic devices at Free-Electron Lasers

Watching proteins function: mixing injector for time-resolved crystallography at X-ray Free Electron Lasers

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Time-resolved crystallography at X-ray free electron lasers is poised to greatly advance enzymology and structure based drug design. The protein microcrystals used in SFX open up the opportunity to study chemically activated reactions. The small dimensions of these crystals allow short soaking times and observation of rapid reactions with atomic detail. We have developed a mixing injector for SFX that can capture transient states occurring milliseconds to seconds after introducing a reactant to the protein crystal [1]. The mixing device is integrated into a gas dynamic virtual nozzle, making it compatible with existing vacuum and atmospheric sample environments at XFELs. It has been successfully used at LCLS, and has proven to be robust and clog resistant, providing hit rates comparable to a standard GDVN. New all-glass construction techniques further improve the device, providing impeccable chemical compatibility and smooth contours to funnel even challenging samples through the mixer.

[1] G. D. Calvey, A. M. Katz, C. B. Schaffer, and L. Pollack, “Mixing injector enables time-resolved crystallography with high hit rate at X-ray free electron lasers,” Struct. Dyn., 3 (2016)