

Plug-and-play polymer microfluidic chips for hydrated, room-temperature fixed-target serial crystallography.

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One of the challenges with serial crystallography (SSX/SFX) is efficient, continuous delivery of hydrated protein crystals to the X-ray beam while maintaining a low scatter background. Fixed-targets offer several advantages over the widely adopted jet-based sample delivery techniques, like- clog-free delivery, significantly lower sample consumption, and the ability to control crystal sample distribution on-chip using surface-functionalization strategies to improve hit-rates.

This work demonstrates the development of versatile, inexpensive polymer microfluidic chips for routine and reliable room-temperature serial crystallography measurements at both synchrotrons and XFEL facilities. Our modular chip design enables direct incorporation of ultra-thin polymer films (2-5 μm) on X-ray windows to drastically cut down background scatter from the delivery platform, and tunable sample flow layers (25-150 μm) to match crystal size and minimize sample volume requirements. The large area, optically transparent chips can be used for in-situ protein crystallization and optimization using vapor diffusion and micro-batch methods to control crystal density and efficiently deliver hundreds to thousands of protein crystals on a single chip as needed. The chips are stable for 2-4 weeks in a humidified environment and 12-24 hours without humidity control in ambient conditions. Therefore, they can be stored and transported stably to X-ray beamlines and used directly for on-chip diffraction measurements, eliminating the need to handle small or fragile crystals altogether.