# Micro-Structured Polymer fixed-Targets (MISP-Chips) For Serial Crystallography at Synchrotrons and Xfels

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Serial crystallography at X-ray free electron lasers (XFELs) and synchrotron light sources, called serial femto-second crystallography (SFX) and serial synchrotron crystallography (SSX), respectively, has proved to be a successful and robust methodology for determining the structures of macromolecules at near physiological temperatures and with minimal radiation damage. To cater for these different experiments, a wide variety of delivery methods have been developed [1, 2]. Amongst these, fixed-targets, based on micro-pattern solid-supports or chips [3] and precise stage-motion [4], have proved to be a strong and dependable approach. Fixed-target sample delivery methods allow for a reduction of sample consumption, rapid optimization of sample loading parameters and are generally easy to use, making them user friendly. Fixed-targets also lend themselves to high throughput technologies and an increased ability to locate and position crystals. Of these currently, only silicon offers the ability to perform an aperture-aligned data collection were crystals are loaded into cavities in precise locations and sequentially rastered through in step with the X-ray pulses [5]. However, the silicon wafers are highly brittle, hugely expensive, prone to fracture and are opaque, making it difficult to know a priori how well crystals have been loaded into the apertures. The polymer based fixed-targets have lacked the precision fabrication to enable this type of data-collection strategy and have been limited to directed raster-scans with crystals randomly distributed across the polymer surface. Here we present a new aperture-aligned polymer-based fixed-target, the Micro-Structured Polymer fixed- targets (MISP-chips) developed for TR-SFX using the SwissMX endstation at the Cristallina experimental station of SwissFEL [Fig. 1]. The MISP-chips, like those made from silicon, have a precise array of cavities and fiducial markers. Using silicon microfabrication and polymer replication technologies, we have designed inverted pyramidal shaped wells in membranes of 50 µm in thickness. This design enables crystals to funnel into predefined positions, optimizing the hit-rate of the probing X-ray beam. The polymer-based film provides low x- ray absorption and scattering background, high design flexibility and the potential for mass-fabrication at low cost. Here we present the methodology for the manufacture of these fixed-targets and a summary of their use at Cristallina for both standard SFX and time- resolved experiments.

*References*

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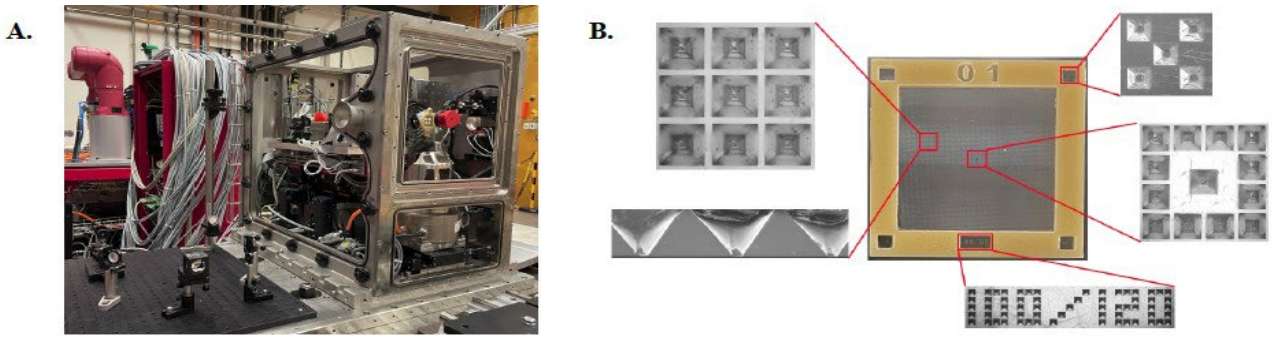


**Figure 1**. **A.** SwissMX fixed-target endstation at the Cristallina experimental station of SwissFEL. **B.** Micro-patterned, polymer-based SwissMX fixed-target composed of inverted pyramidal membrane, fiducials, and a labelling system.

***Figure 1***