Bunching Particles in a Liquid Using Light Pressure

Controlling Sample Particles by Light Radiation

Reference No. P 168

BACKGROUND

Serial femtosecond crystallography (SFX) uses intense femtosecond X-ray pulses from an X-ray free-electron laser (XFEL) to capture diffraction patterns of protein crystals that pass through the X-ray beam. The samples are vaporized after exposure, necessitating repeated measurements with fresh crystals. To achieve this, a slurry of micrometer-sized crystals flows in a liquid jet through the focused X-ray beam. Due to the low duty cycle of X-ray pulses many crystals pass through without being exposed to X-rays. Consequently, data collection for about 100,000 patterns is time-consuming and inefficient, making suboptimal use of XFEL beamtime.

SOLUTION

The invention tackles the issue of low hit rates and slow data collection by bunching crystals in the liquid flow to coincide their release with the arrival of X-ray pulses. We achieve this by briefly optically trapping the crystals e.g., slowing them against the liquid flow, and then releasing them, in intervals. This "catch and release" method locally concentrates crystals into bunches that coincide with X-ray pulse arrivals, with the timing of these bunches synchronized to the pulses. This approach allows to use more dilute sample, hence lower concentration of precious protein samples, and results in a higher diffraction data collection for a given amount of samples.

ADVANTAGES

- Reduces sample volume needed, saving preparation time and cost.
- Minimizes clogging risk, ensuring uninterrupted measurements.
- Enhances XFEL experiment efficiency and beamtime use

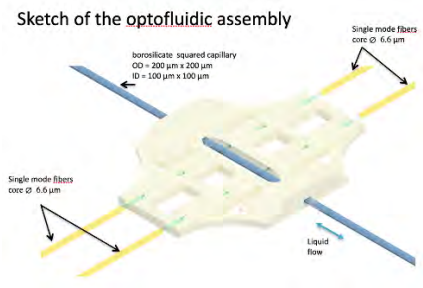

Fig. 1: Optofluidic assembly.

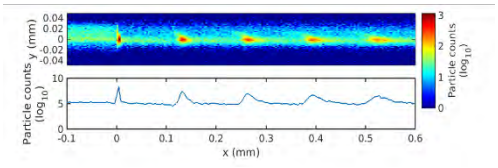

Fig. 2: 2D particle density map.

APPLICATION FIELDS

- Sample preparation for XFELs

PROPERTY RIGHTS

EP 4086615 A1

POSSIBILITIES OF COOPERATION

- Licensing
- R&D Cooperation

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