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A Compact, Reliable Drop-on-Demand Sample Delivery System for Time-Rresolved Serial Femtosecond Crystallography at SACLA

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Serial femtosecond crystallography (SFX) is a method for obtaining damage-free diffraction patterns of protein microcrystals even under near-physiological temperature conditions by utilizing intense, ultrafast X-ray freeelectron laser (XFEL) pulses^{1,2}. Moreover, SFX is applicable to analyze chemical reactions initiated by various triggers, such as substrates, ligands, heat, and light, on timescales of tens of femtoseconds to seconds through probing time-resolved structural changes of protein molecules^{3,4}.

In SFX, however, a large amount of sample consumption has been problematic, as seen in the gas-dynamic virtual nozzle that requires a flow rate of the order of $10 \,\mu$ l/min^{5,6}. Fuller et al. developed a drop-on-tape (DOT) sample delivery system, ejecting a few nanoliter-scale droplets from an acoustic injector onto a moving belt for XFEL irradiation^{7,8,9}.

Recently, we have developed a compact drop-on-demand sample delivery system employing high-frequency piezo-type nanoliter droplet injectors. In this system, the sample droplets attached to a thin polyimide film tape are vertically transported and delivered to the XFEL pulses with high reliability. In contrast to the previous system, the new system is applicable to thin droplets with various viscosities of the sample slurry. Using this device, we have successfully demonstrated mix-and-inject SFX experiments of enzymes with sample consumption as low as that for the high-viscosity injector. Details will be given in the presentation.

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I plan to submit also conference proceedings

No

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