Supplementary Information

In addition to protein crystal retrieval, we conducted experiments using microbeads to validate droplet trapping and subsequent retrieval. Fluorescent microbeads of 1.00 µm diameter (Fluoresbrite® YG Microspheres 1.00 µm, Polysciences, USA) were used. This experiment was performed using an initial device, which differs in the structure of its trap section and harvesting chamber from the device used in the main paper. Figure 1 shows the sequence of operation for this device. This device featured 17 traps (half the number of the device in the main paper). The harvesting chamber was not open at the top; instead, its upper part was designed to be cut open using a scalpel (KAI scalpel No. 11, Yoshida, Japan) after the droplets were trapped. However, this method was not adopted in the final paper because it presented critical issues: vibration during the cutting process often dislodged the droplets or crystals from the traps, and the device was single-use only. The detailed operational sequence and corresponding microscope photographs using this device are shown in Fig. 2.

Figure 2 shows the results of the microbead experiment. Microbeads were injected into the channel from Inlets 2 and 3 at a flow rate of 0.125 µL/min each. Mineral oil with 1 w/w% surfactant (Span 80) was injected into Inlet 1 as the continuous phase at a flow rate of 0.5 µL/min. In the experiments using microbeads, we did not observe the phenomenon of beads being left behind in the trap section when the droplets were moved to the chamber. This is because, unlike the protein crystals which grow within the channel, the microbeads are small and remain suspended within the droplet, making them less likely to contact the channel walls and be dislodged. However, a different problem arose: if the surfactant concentration was too high, even the slight shear forces generated during trapping caused the droplets to rupture and form micro-droplets, into which the beads would then migrate.

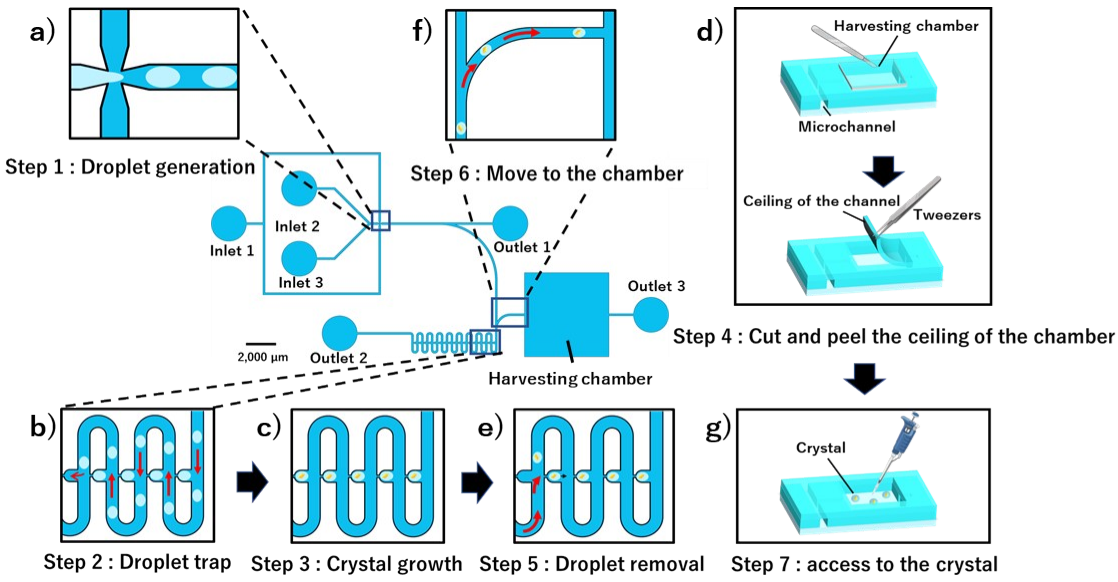

Fig. 1 A series of steps of the extraction method for crystals grown in droplets using a harvesting chamber. (a) Droplet generation using a flow focusing structure. (b) Fixation of droplets using a trap structure. (c) Incubation of crystals in droplets. (d) Cutting out the top of the harvesting chamber. (e) Extraction of droplets from the trap section. (f) Transfer of droplets to the harvesting chamber. (g) Extraction of crystals in the harvesting chamber.

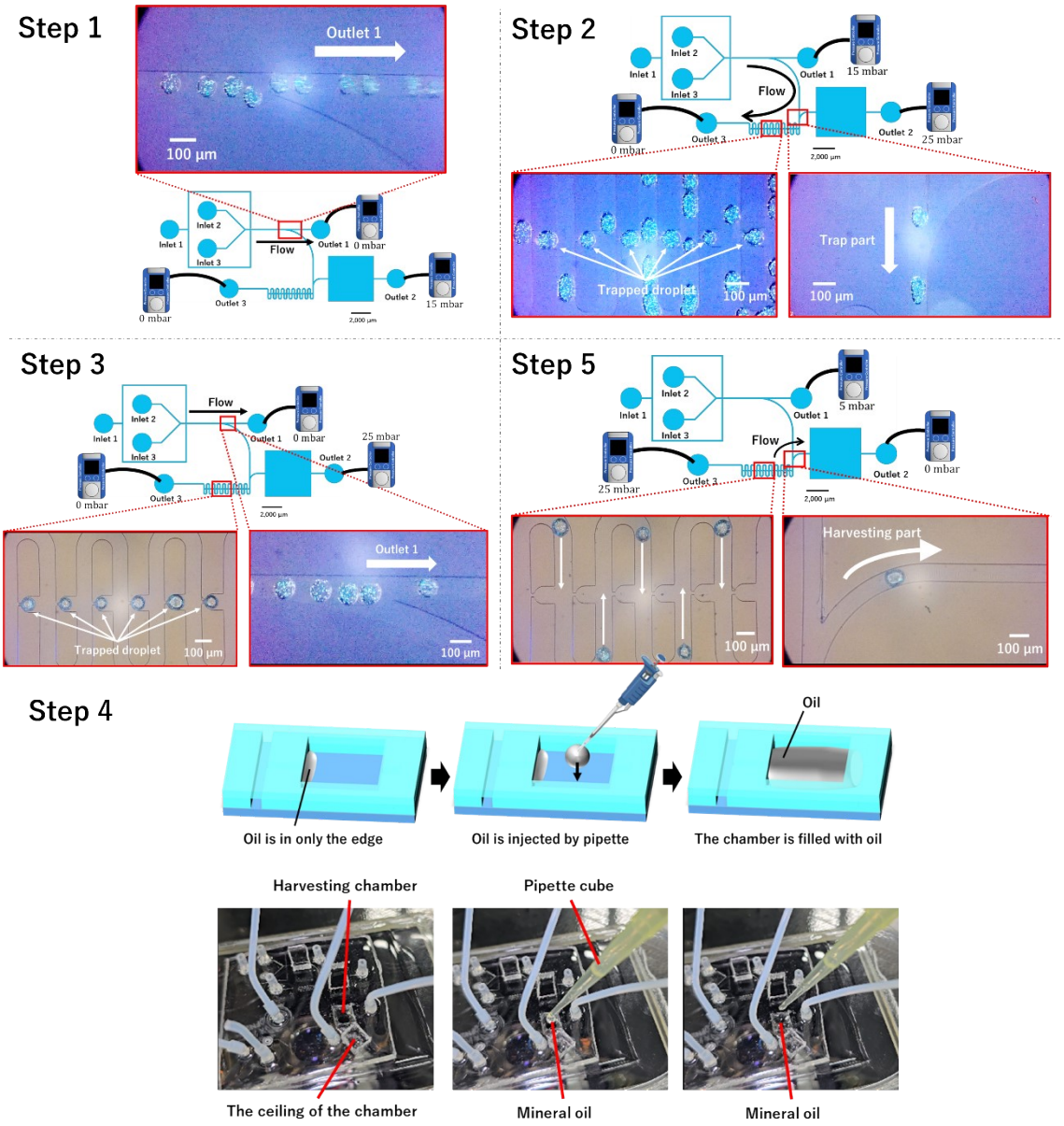

Fig. 2 Sequential operational method from droplet generation to transfer to the harvesting chamber and microscope photographs of droplets. (Step 1) Discard unnecessary bubbles and droplets before stable droplet generation to Outlet 1. (Step 2) After stable droplet generation, trap droplets in the trap section. During this process, control Outlet 2 to prevent droplets from flowing to the harvesting chamber. (Step 3) After droplet trapping, discard unnecessary droplets to Outlet 1 until droplet generation completely stops. (Step 4) Preparation to enhance droplet recovery efficiency. After cutting the upper part of the harvesting chamber and before transferring droplets in Step 5, fill the chamber with oil. This operation moves incoming droplets to the chamber canter, facilitating extraction. (Step 5) Transfer trapped droplets and their contents to the harvesting chamber.

Figure 3 provides a schematic diagram and experimental photograph of the crystal transfer process from the chamber to the glass plate (corresponding to the step shown in Fig. 1(g) and further detailed in Fig. 5 of the main paper).

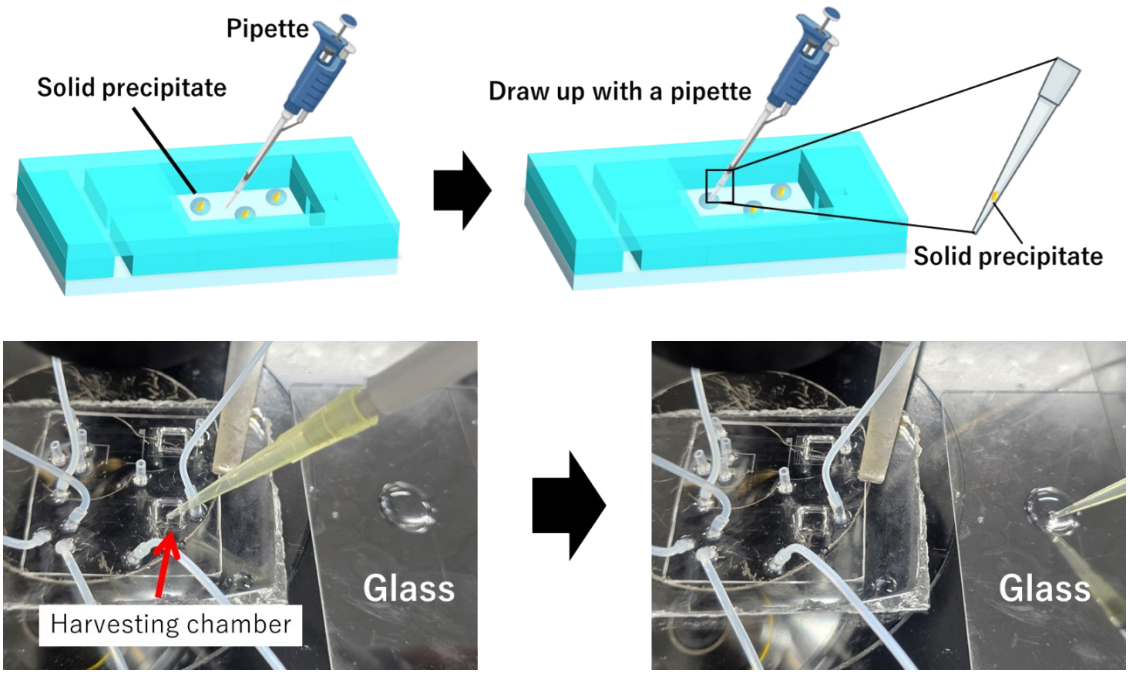

Fig. 3 Schematic diagram and experimental photograph of the crystal transfer from the chamber to the glass plate.

Crystals retrieved onto the glass plate must be stored in liquid nitrogen to prevent damage during data collection at the synchrotron facility and to ensure stability during transport. A microloop is used to hold the crystal while freezing it in liquid nitrogen. Figure 3 shows the crystal being retrieved by the microloop.

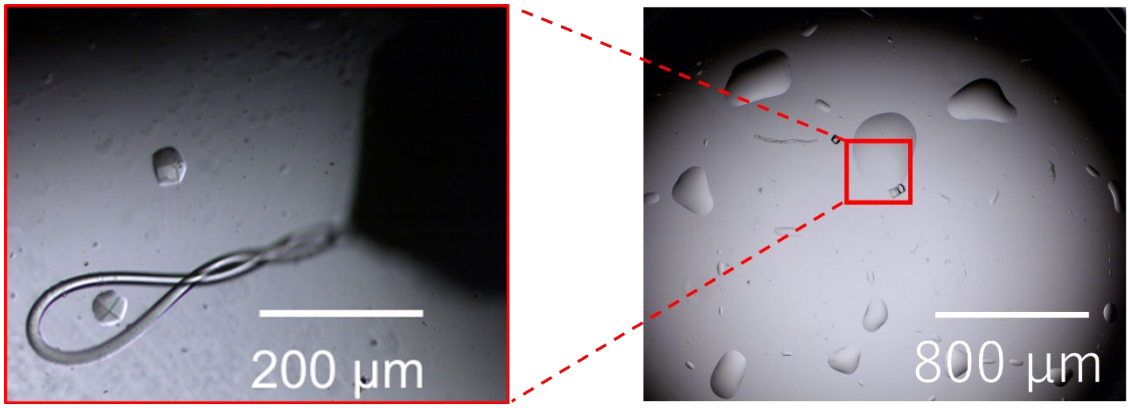

Fig. 4 Microscope image of a protein crystal that was transferred from the harvesting chamber onto a glass plate, and its subsequent retrieval using a microloop.