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Two-phase droplet injectors for studies at X-ray free-electron laser facilities CLAUDIU STAN, SLAC National Accelerator Facility — Hard X-ray free-electron lasers (XFEL) such as the recently developed Linac Coherent Light Source (LCLS) at SLAC deliver pulses with extremely short duration and intensities many orders of magnitude larger than previous sources, to enable visualization of the motion of single atoms within condensed matter. To circumvent X-ray damage, imaging experiments at LCLS are performed serially, with new samples being brought to the vacuum interaction region with X-ray pulses. Continuous liquid microjets in vacuum are currently the best way of carrying and regenerating the samples, but they consume inefficiently scarce samples, such as membrane protein microcrystals. To solve this problem, and to enhance the accuracy of pump-probe experiments, we are developing a two-liquid delivery method in which the sample is carried in disperse-phase drops contained in an immiscible continuous-phase liquid. We will report on (i) the phase-locked generation of sample-carrying droplets with an electrically-assisted axisymmetric flow-focusing device, (ii) methods to reduce the accumulation of phase jitter in the timing of drops during transport, and we will discuss methods for (iii) separating the continuous and disperse phases and (iv) ejection of sample-containing drops into air or vacuum.

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