Impact-induced millisecond clustering during shear melting of colloidal crystals

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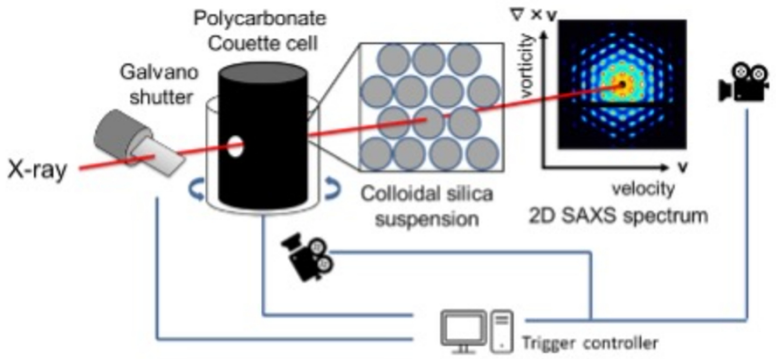
An high-speed shear to a colloidal silica and polymer suspension causes a rapid increase in viscosity called shear thickening. While the phenomenon is well known, it is difficult to investigate thickening process and its mechanism is not understood enough. One reason is that the phase transition of shear thickening occurs in less than one second, making it difficult to observe the transition process in a short time.
Here we investigated time-resolved small/ultra-small angle X-ray scattering (SAXS/USAXS) with a minimum resolution of 1 millisecond using high-brilliance synchrotron radiation in SPring-8 BL19B2 and BL40XU beamline. Simultaneous measurement of viscosity and SAXS/USAXS demonstrated the time development of shear thickening.
Rapid shear increasing on silica suspension showed a shear thickening process in which the particles start to aggregate in few seconds. Our results found a new manner of shear thickening, different from conventional rheo-SAXS under steady shear.

Keywords:
Colloidal crystal, Non-Newtonian fluid, Small angle X-ray scattering



Schematics of a time-resolved Rheo-SAXS system.

References:

[1] K. Akada, *et al., Colloids and Surfaces A,* 658, 5, 130727 (2023)
[2] K. Akada, *et al., Communications chemistry* , (2026) accepted

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