

Dynamic observation of dilatant fluid with X-ray Talbot interferometry

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Dilatant fluid is a kind of non-Newtonian fluid. Normally it behaves like a liquid, but when a drastic force was applied it shows solid-like behavior. Lots of researches were carried out since 1885 when Reynolds discovered this phenomenon. However the origin of the dilatant behavior is not yet revealed. In this work we observed dilatant fluid with high speed X-ray Talbot interferometer with synchrotron white beam [1]. Because of its high intensity, the use of white beam makes it possible to obtain an image within millisecond. The interferometry also has merit that three kinds images (absorption, differential phase and visibility contrast) at once. The visibility contrast image is originating from ultra small angle scattering of unresolved microstructure.

This experiment was carried out at Photon Factory BL-14C. The setup consists of two $5.3 \mu\text{m}$ pitch gratings and an X-ray image detector. And a sample was set in front of the first grating. The detector was comprised of fluorescent screen (P46) and CMOS high speed camera. The positions of the gratings were adjusted so that 25 keV was optimal. The sample was a mixture of cornstarch and water-typical dilatant fluid. It was put in an acryl cell with basal area of 10 mm^2 . We observed the response of the fluid when an acryl rod was dropped into the fluid with frame rate of 1703 fps. After analysis of the images using Fourier transform method, we successfully observed change in visibility contrast due to the dilatancy phenomena. Fig.1 shows visibility contrast image before and after the rod dropped into the fluid. It is seen that visibility is increased in the area just under the rod in the right image. This result indicates that the small angle scattering at the unresolved micro structure was suppressed due to the dropped acryl rod.

[1] A.Momose *et al. Opt.Express* 17, 12540 (2009)

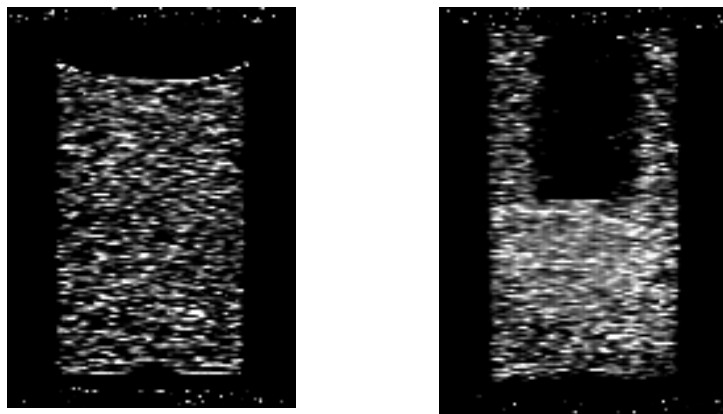


Fig.1 Visibility change of mixture of cornstarch and water.
Left: Before dropping the acryl rod. Right: after dropping the acryl rod.
The black rectangular area in the right image is the acryl rod.