Response and fracture of a viscoelastic fluid under unsteady shear rate

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The transition from flow to brittle fracture (e.g., magma fragmentation in volcanic eruption) is an important and unsolved phenomenon in the modeling of solid earth phenomena. Recently, in the field of soft matter physics, research on the fracture of the complex fluid has been rapidly progressing by new experimental results (e.g., Tabuteau et al., 2011, Soft Matt.). It is pointed out that the viscoelastic properties obtained from conventional measurement (viscosity under steady flow and viscoelastic response under small-amplitude oscillation) cannot express the deformation behavior from the flow to the fracture (Arora et al., 2017, J. Rheol.), because of a remarkably unsteady and large deformation.
We focused on the transition from flow to brittle fracture of the viscoelastic material and changes in physical properties due to an increase in the deformation rate, and started the experiment using soft matter in which viscoelastic effect is easy to measure.
As a viscoelastic test material, we synthesized a gel crosslinking a CpCl microemulsion with polyethylene glycol (Filali et al., 1999, JPhysChem, Ishikawa et al., 2019, JPS abst.). After viscoelastic measurements on a cone plate with a diameter of 25 mm using a rotary rheometer, shear tests were conducted with gradually increasing shear rates at given acceleration (0.1, 1, 10, 100 s^{-2}). In this presentation, we will report the response at each shear acceleration in comparison with the solution for the linear Maxwell fluid. We will also introduce the photoelastic visualization of fracture.

