Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Viscoelastic fluid-structure interactions in microfluidics[1] SIMON HAWARD, CAMERON HOPKINS, AMY SHEN, Okinawa Institute of Science and Technology — Flow of a viscoelastic wormlike micellar solution around a slender, but rigid, microfluidic post at negligible Reynolds number (Re<<1) undergoes a supercritical bifurcation to a steady asymmetric state when a critical Weissenberg number (Wi) is exceeded. A second transition above a higher critical Wi results in time-dependence of the asymmetric flow with a characteristic frequency $1/\lambda_{\mathrm{M}}$, where λ_{M} is the Maxwellian relaxation time. We examine the effect of this time dependence on the behavior of flexible cantilevered micro-posts, showing post oscillations at the same characteristic frequency $1/\lambda_{\mathrm{M}}$, thus demonstrating a "purely-elastic" fluid-structure interaction. A second flexible post positioned downstream, shows a remarkable degree of synchronization with the first. The time lag between their correlated motions is much shorter than any expected flow time between the two posts. Our experiments show that the posts are effectively linked by an elastic strand of highly stressed fluid originating in the wake of the upstream post. Our results indicate that the time lag between their motion is dictated by the speed of the elastic wave traveling along this strand.

[1]JSPS grant nos. 17K06173, 17J00412, 18K03958, 18H01135

Simon Haward
Okinawa Institute of Science and Technology

Date submitted: 29 Jul 2019 Electronic form version 1.4