

# DWS microrheology in biopolymer and suspension formulations

## Webinar Q&A Transcript

### **1 With the examples using polystyrene tracers in filamentous samples - what is the tracer size range that can be used and does tracer size limit the range of moduli that can be measured?**

Tracer sizes depend on the structure of the polymer solution, and typically must be larger than the mesh size. Of course, the modulus range of the experiment depends on the tracer size, too. Using smaller tracer particles can offer access to measuring higher compliance materials by adjusting the experimental setup. Thus, judiciously choosing the particle size allows for flexibility in exploring a broader range of material moduli within the constraints of the continuum limit.

### **2 How do you choose the size of the tracer? Is it dependent on the size of the molecule in suspension, assuming it is a uniform suspension (monodisperse in nature)?**

In a microrheology experiment, tracers are typically chosen such that they are larger than any characteristic material length scale – the principal concern is that the material around the tracers must deform as a continuum to meet the assumptions of the GSER.

### **3 Are there limitations of the DWS measurements to provide meaningful rheological information as suspended materials become larger (approaching 1000 nm, or larger) and less spherical (aspect ratios approaching 3:1)?**

Certainly, as particles become larger, their Brownian motion becomes smaller and potential motion driven by sedimentation becomes more significant. The upper limit of particle sizes we've typically measured is on the order of 3 micrometers. However, we did study "dumbbell" particles and measured the (average) diffusivity.

#### **4 What would be a suggested limit on the polydispersity index for a suspended material?**

For a tracer microrheology experiment, the suspended particles should be as monodisperse as possible. A typical coefficient of variation will be 1-2% for polystyrene particles.

#### **5 How complicated would a pressurized system have to be to explore pressures not quite as high, e.g., 1000kPa (water vapor pressure at 180C)?**

We made measurements at pressures up to 2000 bar (200 MPa), which requires a fairly thick, tempered steel sample cell. Details are provided in Dennis, K. A.; Gao, Y.; Phatak, A.; Sullivan, P. F.; Furst, E. M. Design, Operation, and Validation of a Microrheology Instrument for High-Pressure Linear Viscoelasticity Measurements. *Journal of Rheology* 2020, 64 (1), 205–212. <https://doi.org/10.1122/1.5126682>. I expect that the sample cell could be significantly smaller at lower pressures.

#### **6 How can microrheology testing help in predicting polymer degradation during enhanced oil recovery?**

As a sensitive measure of rheology, especially viscosity, microrheology could be used to detect changes in the molecular weight due to polymer scission.