

Topic: Rheology of soft solids.

A large number of materials of industrial and consumer utility belong to a class called as soft solids. Examples include personal care products such as shampoos and hair gels, food products such as dough and ice-cream, and industrial products such as paints, slurries and composites. Soft solids are typically characterized by internal microstructure at nanometer to micron length scales. Soft solids exhibit certain universal rheological features such as presence of yield stress, weakly frequency dependent shear moduli and a maximum in loss modulus at intermediate shear strains. In a recent study it has been proposed that oscillatory shear experiments when performed by keeping constant the effective shear rate ($\omega\gamma_0$) result in shear moduli which can be shifted horizontally to give mastercurves. The shifting suggests a specific dependence of the longest relaxation time of soft solids on the shear rate. This experiment is called the Shear Rate Frequency Sweep (SRFS) experiment.

In a SRFS experiment the low frequency data has to be necessarily generated at large (non-linear) strains. We are studying the large amplitude oscillatory shear (LAOS) response of soft solids in the SRFS mode, and we find that all harmonic moduli of the stress follow the SRFS superposition with identical shift factors. We also find that the dissipation in the material is confined to the first mode as expected from theory, and that other modes represent energy that is stored or recovered. We also see preliminary indications of energy transfer between modes.

