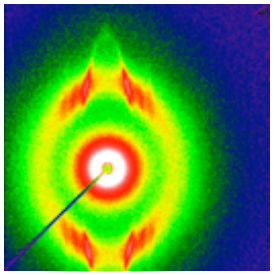

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Keynote 3 - Vorticity banding in shear-thickening suspensions

Monday, 10 December 2018 16:00 (40)

Discontinuous shear thickening of dense suspensions is a phenomenon in which, at a specific shear rate, the viscosity increases discontinuously often by orders of magnitude. Recent modeling of the phenomenon suggests that the viscosity jump in rate-controlled rheometry corresponds to an underlying S-shaped flow curve in stress-controlled conditions. This nonmonotonic rheology was observed in simulations with modest particle numbers, showing a range of shear stresses for which the shear rate is a decreasing function of the shear stress. In general, however, one expects that for large enough systems a decreasing flow curve leads to a mechanical linear instability of the uniform flow and the appearance of banding or rheo-chaos in the nonlinear regime. The exact mode of instability is nonetheless quite difficult to predict in absence of a proper tensorial constitutive model. In this talk I will show particle-based numerical simulations of thickening suspensions exhibiting an instability along the vorticity direction and subsequent "traveling" vorticity bands. Interestingly, because the mechanical description of the vorticity direction can be decoupled from the flow and gradient directions, a one-dimensional (scalar) constitutive model is enough to capture most of the features observed in the simulations. This model also gives hints as to the origin of the unsteady rheological response observed in experiments performed in similar conditions.

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Session Classification : Later afternoon session - Colloids