Shear thickening and S-shaped flow curves ROMAIN MARI, Levich Institute, CCNY, RYOHEI SETO, Levich Institute, CCNY / Okinawa Institute of Science and Technology, JEFFREY F. MORRIS, MORTON M. DENN, Levich Institute and Department of Chemical Engineering, CCNY — The discontinuous shear thickening (DST) of dense suspensions is a remarkable phenomenon in which the viscosity can increase by several orders of magnitude at a critical shear rate. It follows the phenomenolgy of a first order transition between two "states" that we have recently identified as Stokes flows with lubricated or frictional contacts, respectively. Here we extend the analogy further and show the existence of a non-monotonic steady state flow curve by means of stress-controlled simulations, analogous to a non-monotonic equation of state. While we associate DST to an S-shape flow curve, at volume fractions above the shear jamming transition the frictional state loses flowability and the flow curve reduces to an arch, permitting the system to flow only at small stresses. Whereas a thermodynamic transition leads to phase separation in the coexistence region, we observe a uniform shear flow all along the thickening transition. A stability analysis suggests that uniform shear may be mechanically stable for the small Reynolds numbers and system sizes in a rheometer.

Romain Mari
Levich Institute, CCNY

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