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Viewing stress-activated frictional constraints and shear thickening of dense suspensions through the lens of particle surface chemistry[1]
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The mechanism of shear thickening in dense suspensions has been linked to a stress-controlled transition from unconstrained lubricated (frictionless) to constrained unlubricated (frictional) rheology. However, it is unclear how these constraints are affected by particle surface chemistry. We show that simulations incorporating reasonable values of sliding friction with a small amount of rolling friction can collapse experimental data covering orders of magnitude in particle size and different particle-fluid chemistries simply by scaling the onset stress for shear thickening. Still, there are notable exceptions where enhanced hydrogen bonding between particles decreases the jamming volume fraction in a manner analogous to sticky or rough particles, which can only be modelled using higher rolling and/or sliding friction coefficients. These observations thus connect the stress-activated formation of hydrogen bonds at the particle surface to rolling and sliding constraints and macroscopic shear thickening behavior.

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