

Simplified Industrial Formulations – Collaboration with J. Vermant

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Sponsor acknowledgement:



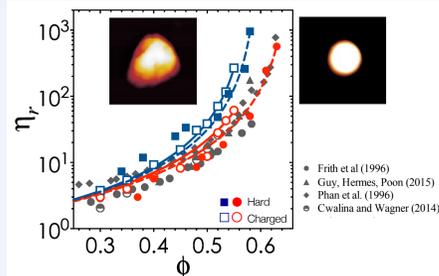
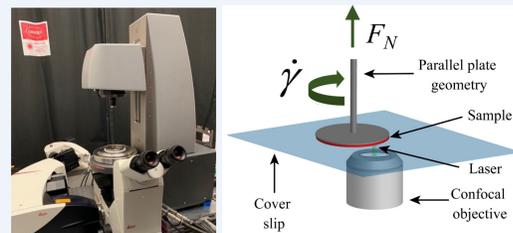
Motivation

Understand how roughness impacts suspension tribology and rheology using model systems that translate to simplified industrial formulations (SIFs)

1. Characterize sterically stabilized PMMA colloids of different surface roughness in flowing systems
2. Measure shear thickening, linear viscoelasticity, creep recovery, and tribology of model systems
3. Compare results to industrial formulations

Characterization

Ultrafast structural imaging during flow

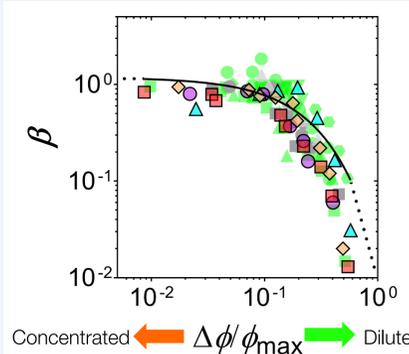
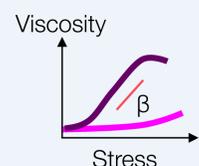


Viscosity and max. packing

$$\eta_{res} = [1 + 1.5(1 - \phi/\phi_{max})^{-1}]^2$$

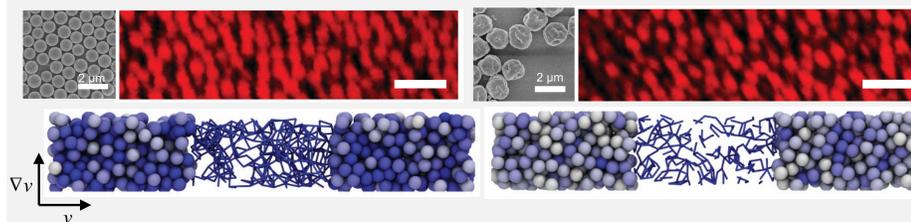
ϕ_{max}	Smooth	Rough
Hard	0.66	0.60
Charged	0.63	0.58

Shear thickening correlations

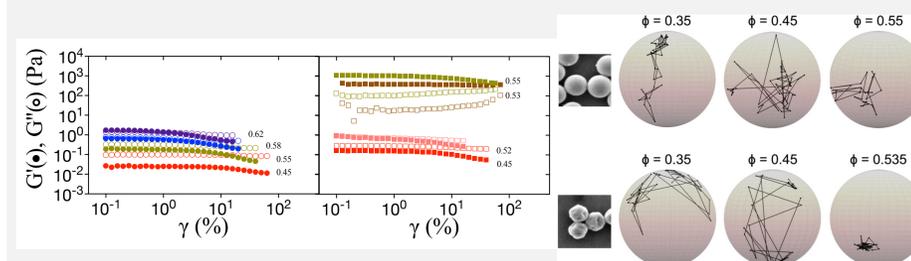


Jamming effects on SIFs

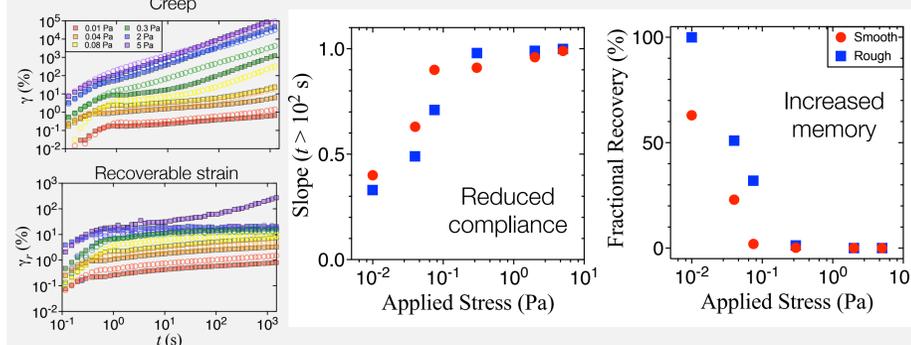
Shear thickening



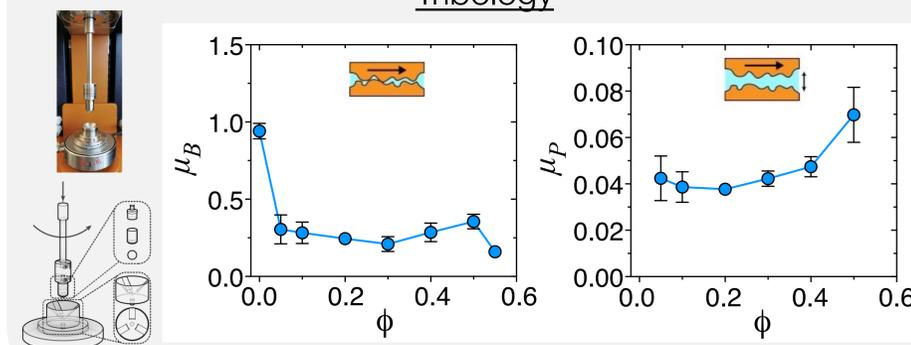
Linear viscoelasticity



Creep and recovery



Tribology

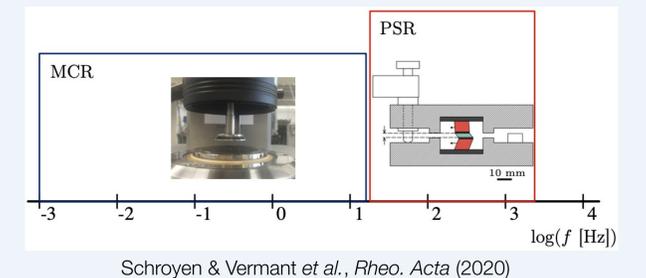


Collaboration with Vermant group

1) High frequency rheology

Can high frequency response be linked to viscoelasticity?

- Bench method to probe rheological properties under vibrations

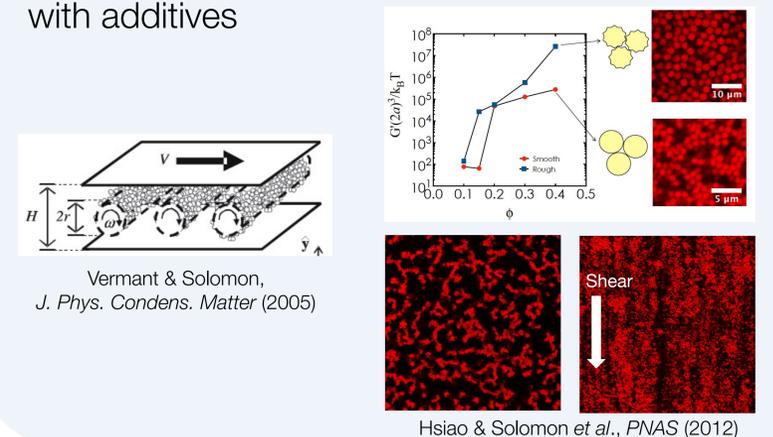


Schroyen & Vermant et al., *Rheo. Acta* (2020)

2) Sheared SIFs with additives

Does particle friction lead to different gel properties?

- Processing and manufacturing of formulations with additives



Vermant & Solomon, *J. Phys. Condens. Matter* (2005)

Hsiao & Solomon et al., *PNAS* (2012)

Selected publications on suspensions and gels:

1. S. Pradeep, A. Wessel & L. C. Hsiao. Under review at *J. Rheology* (2022).
2. S. Pradeep, M. Nabizadeh, A. R. Jacob, S. Jamali & L. C. Hsiao. *Physical Review Letters* (2021).
3. K. M. Smith, A. San-Miguel & L. C. Hsiao. *Physics of Fluids* (2021).
4. L. C. Hsiao & S. Pradeep. *Current Opinion in Colloid & Interface Science* (2019).
5. L. C. Hsiao, R. S. Newman, S. C. Glotzer & M. J. Solomon. *Proceedings of the National Academy of Sciences USA* (2012).