Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Extreme anisotropy: how does a sheet-like particle of atomic thickness behave in a shear flow?[1] LORENZO BOTTO, Process and Energy Department, Delft University of Technology, CATHERINE KAMAL, SIMON GRAVELLE, School of Engineering and Materials Science, Queen Mary University of London — Graphene and other 2D nanomaterial interact with liquids in applications ranging from graphene inks to nanocomposites, forming suspensions of sheet-like particles of extreme aspect ratios. We considered the rotational dynamics of nanometrically thin nanoplatelets in simple shear flow, simulated via Molecular Dynamics and Boundary Integral simulations. When the surface of the platelet exhibits slip lengths$\lambda$is larger than the particle thickness, the classical tumbling dynamics predicted by Jeffery is suppressed: the particle attains a stable orientation without rotating [Kamal, Gravelle, Botto. Nat. Comm. 11.1, 2020]. This effect is robust for 2D nanomaterials - graphene has $\lambda = O(10nm)$- and can leads to a substantial reduction in the effective suspension viscosity. We have identified 3 regimes of orientation depending on the rotational Peclet number Pe. Although a stable orientation is achieved only for Pe >>1, slip affects the orientational distribution function for a wide range of intermediate Pe numbers, by decreasing the probability of observing complete rotation events. The talk will also discuss why graphene research is a fertile area for the multiphase flow community to make technological impact.

[1]This project has received funding from the European Research Council (ERC) through grant No. 715475

Lorenzo Botto
Process and Energy Department, Delft University of Technology

Date submitted: 10 Aug 2020 Electronic form version 1.4