Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Stable alignment of a flexible sheet-like particle in shear flow: effect of surface slip and edges.[1] CATHERINE KAMAL, SIMON GRAVELLE, School of Engineering and Materials Science, Queen Mary University of London, LORENZO BOTTO, Process and Energy Department, Delft University of Technology — Very thin sheet-like particles presenting hydrodynamic surface slip (e.g., graphene colloids and other 2D nanomaterials) can attain a constant orientation in a shear flow when the slip length exceeds a length scale comparable to the particle thickness. To study the effect of bending deformations on this phenomenon, we develop a 2D fluid-structure interaction model, based on coupling the Euler-Bernoulli beam equation with a Boundary Integral method, of a flexible plate rotating in a simple shear flow. We find that: i) a stable alignment is observed even for relatively flexible particles - non-dimensional bending rigidity$\sigma_B/(\mu\dot{\gamma}a^3) << 1$, where $\sigma_B$is the bending rigidity, $a$is the major semi-axis, $\dot{\gamma}$is the shear rate, and$\mu$is the fluid viscosity; ii) the effect of the edges on the shape of the plate is important, for values of the aspect ratio a/b at least as large as 100. In our parameter range, the mild effect of flexibility on orientation is primarily due to the markedly reduced axial compressive stresses that a flow-oriented sheet presenting slip experiences, compared to a no-slip sheet. Our results are particularly relevant in view of recent research on graphene suspensions.

[1]This project has received funding from the European Research Council (ERC) under the European Unions Horizon 2020 research and innovation programme (Grant agreement No. 715475)

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Date submitted: 10 Aug 2020 Electronic form version 1.4