Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Drag reduction of a sphere with oscillation in pseudo-plastic fluid XIANPING ZHANG, KAZUYASU SUGIYAMA, MINORU IWAMURO, TOMOAKI WATAMURA, Graduate School of Engineering Science, Osaka University — A force acting on a spherical particle or bubble moving in pseudo-plastic fluid is numerically investigated. The sphere motion is characterized by prescribed translational and oscillating velocities. The unsteady Stokes equation together with the power-law viscosity $\mu = K\dot{\gamma}^{n-1}$ (here, K is the consistency factor, $\dot{\gamma}$ is the shear rate, and n is the power index) is solved by a finite-difference approach with varying n and the oscillation amplitude A. With increasing A, the time-averaged drag force reduces due to the enhanced shear-thinning effect. Such a drag reduction is more remarkable with decreasing n, and is arranged by two scaling relations for small A and for large A. Examining the instantaneous and time-averaged velocity distributions, we discuss the relevance of the Stokes boundary layer near the sphere surface and the nearly irrotational velocity in the bulk.

Kazuyasu Sugiyama
Graduate School of Engineering Science, Osaka University

Date submitted: 31 Jul 2019 Electronic form version 1.4