July 15, 2023

Physical Review Fluids
Professor Eric S. G. Shaqfeh, Editor

Dear Prof. Shaqfeh,

Please find enclosed the revised version of our manuscript (FZ10233): "Numerical Simulation of Bubble Deformation and Breakup under Simple Linear Shear Flows" We thank the reviewers for their comments and thoughts regarding improvement of our paper. We believe that we have addressed all of the reviewers' concerns; the changes are itemized in detail below.

NOTE: all references to equations and figures below are with reference to the numbering scheme of the revised version of the paper, not the original version. Also, changes are hi-lighted in red.

Changes made in response to comments of Reviewer 1:

1. This is an excellent manuscript and I recommend acceptance.
   The main results are figure 11 where the boundary between bubbles that break up and those that do not is plotted in the Ca-Re plane. If possible, it would be interesting it the authors could include also the boundary for drops. As the authors point out, the main difference between bubbles and drops are the ratios of the material properties. It would be interesting to see in more detail how the breakup modes and the boundary between breakup and no breakup depends on those. My guess is that the viscosity ratio is more important than the density ratio.

   Response:
   We really appreciate your compliment.
   We have added a drop critical curve with λ (density ratio) =1 and η (viscosity ratio) = 1 to Fig. 11. Also, we have mentioned the difference between both critical curves.
   Additionally, we have examined the effect of λ and η on drop breakup for the following combinations of λ and η:

   1. $\lambda = 1.0$, η =1.0 (done)
   2. $\lambda \simeq 0.0$, $\eta \simeq 0.0$ (this study)
   3. $\lambda = 1.0$, $\eta \simeq 0.0$
   4. $\lambda = 1.0$, η =0.1
   5. $\lambda = 0.1$, η =1.0
   6. $\lambda = 0.1$, η =0.1
   7. $\lambda = 1.0$, η =100
   8. $\lambda = 1.0$, η =1000

   Although computations for all these conditions have not been completed, we have found out that the effect of the viscosity ratio on drop deformation

is larger than that of the density ratio, as the reviewer expected. We will also present our research on the effect of density and viscosity ratios on a future journal paper.

On behalf of the authors,

Mitsuhiro Ohta