Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Modulation of flow transition in microbubble Taylor-Couette flow
TOMOAKI WATAMURA, Osaka University, YUJI TASAKA, YUICHI MURAI, Hokkaido University — To examine the interaction mechanism of bubbles and flows that result in drag reduction, the effect of the presence of microbubbles on a flow state is experimentally investigated in a Taylor-Couette flow with azimuthal waves. The average diameter of the bubbles is 60 μm, which is smaller than the maximum length scale of vortices in the flow, and the maximum void fraction is 1.2×10^{-4} at the maximum case. The modifications of the fluid properties, bulk density and effective viscosity are expected to have a small effect on modifying flow states. The power of the basic wave propagating in the azimuthal direction is enhanced; its modulation, however, is decreased by adding microbubbles in the flow regime corresponding to modulated Taylor vortex flow. Moreover, the gradient of the azimuthal velocity near the walls, source of the wall shear stress, decreases by 10%. The modified velocity distribution by adding microbubbles is comparable to that obtained with a 20% lower Reynolds number. Microbubbles in the wavy Taylor vortices are visualized and exhibit a preferential distribution and motion at the crests and troughs of the waviness. We discussed the effect of the extra buoyant force due to the inhomogeneously distributed microbubbles in wavy structures on the flow.

Tomoaki Watamura
Osaka University

Date submitted: 25 Sep 2017 Electronic form version 1.4