Drag modulation in two-phase Taylor-Couette flow with droplets

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Direct numerical simulations of immiscible and incompressible two-phase flows in a Taylor-Couette system were carried out using a three-dimensional volume-of-fluid method with the piecewise linear interface construction. In this work, drag modulation in two-phase flow with droplets was investigated. Two distinct drag modulations, namely, drag enhancement and drag reduction were found under different parameter ranges. To elucidate the mechanism of the distinct drag modulations, the interactions between the interface and Taylor vortices were studied based on the droplet distribution. The influence of droplets on the angular momentum transport was studied by showing the variation of viscous and advective contributions. The averaged shear stress and Reynolds stress as a function of radial position were also investigated to show the stress variation induced by droplets. Present results provide in-depth information on the interactions between the interface and the flow field, which could promote the understanding of the mechanism of drag modulation of two-phase flows.

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