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Sweeping and redevelopment of longitudinal vortices in a turbulent boundary layer by injecting bubble swarms HYUN JIN PARK, YUJI TASAKA, YUICHI MURAI, Hokkaido Univ — We performed injection of bubble swarms, which consist of leading air films and following smaller bubbles, into a turbulent channel flow to investigate interaction between turbulent vortices and small air films. Advection of the air films flowing along the channel wall is faster than the streamwise vortices in a turbulent boundary layer, and thus the vortices in the boundary layer are swept by the air films. Our question is what happening on the vortices after sweeping? We visualized the vortices, and it elucidated that the swept vortices survive beneath the air films without dissipating and bursting. This was also confirmed on the corresponding measurement of Reynolds shear stress. Then the vortices return to the wall after escaping from beneath the air films. After that the redevelopment of the vortices occurs and original condition of the boundary layer is restored. Reduction of Reynolds shear stress is still continued even beneath smaller bubbles in middle part of the bubble swarms and it suggests that redevelopment of Reynolds shear stress event, bursting of streamwise vortices mainly, cannot occur quickly even with survival of the vortices. As a result, the bubble swarms reduce frictional drag more than continuously injected bubbles at the same volume fraction of bubbles.

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