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Wall-induced path variation of a large deformable rising bubble[1]

HYUNGMIN PARK, HYEONJU JEONG, Seoul National University — In the present study, we experimentally investigate the wall-induced path variation of a large deformable bubble ($Re \sim \boldsymbol{O}(10^3)$) rising near a vertical wall in quiescent water. To change the wall effect, we consider different wall materials (acrylic, PTFE and sponge) and vary the initial distance between the bubble and the wall. Depending on the conditions, various motions like a periodic bouncing, sliding, migrating away, and non-periodic oscillation without collisions are captured. Analysis on the energy balance shows that, contrary to a low-Re bubble, the surface deformation plays a great role in bubble's rising behaviour. Especially, across the bubble-wall collision, the excessive surface energy compensates the deficit of kinetic energy, which enables the bubble to maintain a constant bouncing kinematics, despite the wall effect. The wall effect, appearing as a energy loss, decreases as the distance to the wall increases. Compared to the no-slip surface, the hydrophobic surface enhances or reduces the wall effect with the wall distance, whereas the porous surface reduces the energy loss due to the wall. The dependence of near-wall bubble motion on a wall configuration may give us an idea about how to predict or model the near-wall gas void-fraction.

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