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Modeling of a single clean bubble bouncing on a free surface MASAO WATANABE, Hokkaido University, AYAKA SATO, MINORI SHIROTA, Hirosaki University, TOSHIYUKI SANADA, Shizuoka University — Bouncing of a rectilinearly rising bubble on a free surface is modeled with the use of a simple mass-spring system. We use an equation of motion of the system that consists of two springs connected in series, which allows us to account for the restoring forces of both the bubble and free surfaces, and a conservation equation of energy, which allows us to describe an exchange between the surface energy due to deformations of both the bubble and free surfaces and the kinetic energy of the bubble. We can determine that the contact time, i.e. the time duration of a bubble contacting a free surface, should be a half of the characteristic period of the oscillator. We also observe a single clean bubble bouncing on a flat free surface in ultrapure water in order to verify the present model. Analytical and experimental results agree quite well, even in the cases with significant surface deformations. When bubbles are smaller than 0.6 mm in radius, the deformations of both the bubble and free surfaces play important roles in bouncing. In the case of larger bubbles, bouncing is dominated by the free surface deformation since the bubble has already been highly deformed before collision.

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