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STUDY OF BUBBLE BEHAVIOR IN WEIGHTLESSNESS (EFFECTS OF THERMAL GRADIENT AND ACOUSTIC STATIONARY WAVE)
M-16

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The aim of this experiment is to understand how bubbles behave in a thermal gradient and acoustic stationary wave under microgravity. In microgravity, bubble or bubbles in a liquid will not rise upward as they do on Earth but will rest where they are formed because there exists no gravity-induced buoyancy. We are interested in how bubbles move and in the mechanisms which support the movement. We will try two ways to make bubbles migrate.

The first experiment concerns behavior of bubbles in a thermal gradient. It is well known that an effect of surface tension which is masked by gravity on the ground becomes dominant in microgravity. The surface tension on the side of the bubble at a lower temperature is stronger than at a higher temperature. The bubble migrates toward the higher temperature side due to the surface tension difference. The migration speed depends on the so-called Marangoni number, which is a function of the temperature difference, the bubble diameter, liquid viscosity, and thermal diffusivity. At present, some experimental data about migration speeds in liquids with very small Marangoni numbers have been obtained in space experiments, but cases of large Marangoni number are rarely obtained. In our experiment a couple of bubbles are to be injected into a cell filled with silicon oil, and the temperature gradient is to be made gradually in the cell by a heater and a cooler. We will be able to determine migration speeds in a very wide range of Marangoni numbers, as well as study interactions between the bubbles. We will observe bubble movements affected by hydrodynamical and thermal interactions, the two kinds of interactions which occur simultaneously. These observation data will be useful for analyzing the interactions as well as understanding the behavior of particles or drops in materials processing.

The second experiment concerns bubble movement in an acoustic stationary wave. It is known that a bubble in a stationary wave moves toward the node or the loop according to whether its diameter is larger or smaller than that of the main resonant radius. In our experiment fine bubbles will be observed to move according to an acoustic field formed in a cylindrical cell. The existence of bubbles varies the acoustic speed, and the interactive force between bubbles will make the bubble behavior collective and complicated. This experiment will be very useful to the development of bubble removal technology as well as to the understanding of bubble behavior.