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Bubble Characteristics in Different Microbubble Generation Methods

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Abstract. Microbubbles are very small bubbles with diameters of about 1-100μm, and their chemical and physical properties are different from those of small bubbles (millibubbles). A important characteristic of microbubbles is that they are electrically charged on the gas-water interface (ζ-potential). Microbubbles with high ζ- potential are attracted to materials with different potentials. Because of these characteristics, microbubbles have significant potential to be used for a variety of practical purposes. However, the effect of the electrical potential on shrinkage behavior of microbubbles has not been clarified yet. In the present study, the relationship between the shrinkage behavior of microbubbles and ζ-potential is investigated by using two types of microbubble generating method (slit type and pressurized dissolution type). The slit type microbubble generator consists mainly of a pipe with slits and an air supply tube that is set upstream of the slits in the pipe. This generator was developed in our laboratory. The pipe water flow is only discharged from the slits into the water tank, and a shearing force is produced by changing the flow direction at the corner of the slits. The Pressurizing dissolution type generated microbubbles by decompressing liquid containing gas dissolved at high pressure. The bubble diameter of the pressure dissolution type is smaller than in the slit type. The ζ-potential measurements were carried out by using a water reservoir with the microbubble generator, an electrophoresis cell, consisting of two electrodes, a constant voltage power source, a pump, a camera system, and a personal computer. The ζ-potential was calculated from electrophoretic mobility in the horizontal direction using the Smoluchowski equation. Microbubbles generated by the slit-type generator showed higher electrical potential on the gas-water interface than those generated by the pressurized dissolution type generator. We observed shrinkage behavior of microbubble in the degassed water (gel) by a high-speed microscope. It was confirmed that shrinkage behavior of microbubbles was strongly affected by the ζ-potential of microbubbles.

Keywords: gas-liquid two-phase flow, microbubbles, zeta potential,