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Formation mechanisms and lengths of the bubbles and liquid slugs in a coaxial-spherical micro mixer in Taylor flow regime

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Abstract

One of the most important problems of the efficiency of mini and micro devices (with diameter larger than ~ 1 mm) for gas-liquid systems is the maintenance of regular Taylor (slug) flow regime. The paper describes a coaxial-spherical mixer (CS-mixer), which allows to create a slug flow regime in a wide range of phase flow rates. For CS-mixer a flow map was build up and superimposed to that for C-mixer.

It was shown experimentally with 2 mm ID microchannel that the position of the nozzle for the injection of the gas relative to the spherical extension of CS-mixer significantly affects the lengths of the bubbles and the slugs generated in the micromixer. Two nozzle positions in the narrowing part of spherical extension were considered as optimal from the point of view of uniformity of slug flow.

For nozzle position D (middle cross-section), which was studied more detailed in this research, equations for bubbles and slugs lengths were obtained. Values of bubbles and slugs lengths calculated by these equations were compared with data of other authors for different types of micro-mixers. It was shown that CS-mixer allows to control the length of the bubbles and to generate bubbles with smaller length. The size of the slugs produced by CS-mixer demonstrated weaker dependence on superficial liquid flow rate compared to the other types of micromixers. Unexpected (for other types of micromixers) behavior of two-phase flow in