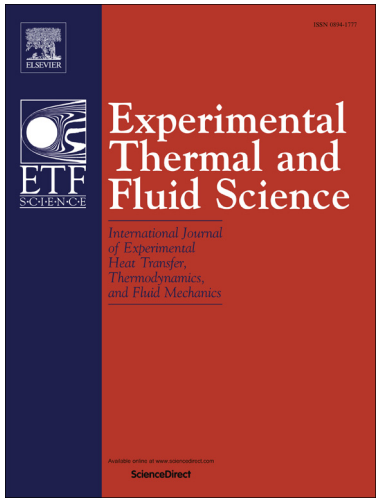

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EXPERIMENTAL STUDY ON THE SLUG FLOW IN A SERPENTINE MICROCHANNEL

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A B S T R A C T

In this paper the attention was focused on the characterization of the slug flow generated by two fluids upstream (air-water) in serpentine micro-channels with squared sections and widths of {*640, 320*} *μm*. The curved geometries and the channels width greater than 100 *μm* increases the complexity of the microfluidic process due to a weak presence of turbulence and inertial effect. All that produces the flow speed up and the enhancement of the mixing, but at the same time, a loss in the process control. The results presented are related to the changes in the slug flow pattern due to the different geometries, the varying the input flow rates and the investigated channel positions. A wide experimental campaign of a total of 69 experiments, divided in three experimental sets *{set-1, set-2, set-3}* was carried out.

Two-phase microfluidic processes were monitored optically acquiring signals related to the light intensity variations in a selected channel position. Two flow patterns, slow and fast, were identified and, the signals analysis procedure used, has allowed their association to specific dynamical features both in time and in frequency domains. Four indicators were introduced for a quantitative evaluation of these features in the different operative conditions. The results have provided a characterization of the dynamics even though the nonlinearity of the process. In *experimental set-1*, comparing the flow patterns in two micro-channels with straight and serpentine geometries and width *320 μm*, it was proved the drastic changes induced in the flow displacement by the curves in terms of number of slugs and air/water presence. In *experimental set-2*, using a serpentine micro-channel with width *640 μm*, it was investigated the role of the input flow rate in the pattern formation and stabilization in terms of bubbles length, frequency and inter-distance

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