Simulation and Experimental Study of Single and Two Phase flow in Microchannels

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Over the last two decades there has been an explosion in the use of micro-structured devices to achieve high heat transfer rates and well-controlled chemical reactions. Applications include bioassay devices on micro-chips and highly compact heat exchange devices, ranging in scale from those suitable to cool a micro-chip to compact heat exchangers.

At first sight the reduction of size, leading to flows falling in the laminar regime, might suggest that the understanding would be very simple. However, it turns out that there are many complexities, with the occurrence of transient flows at much lower Reynolds numbers than might be expected. The introduction of a second phase introduces the complexities of surface tension and wettability.

This presentation will focus on two aspects of this problem, covering single and multiphase flows. The first part will address the simulation and experimental study of single phase flow and heat transfer in tortuous channels. The second part will present results for the numerical and experimental investigation of Taylor flow – which occurs widely in two phase flow. We show that ANSYS CFX and Fluent are highly suitable for these types of simulation and are sufficiently flexible to allow extensive modification/customisation as needed.

If time permits some recent work on annular flow boiling will be introduced.