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Preface

The International Conference on Heat Transfer and Fluid Flow in Microscale (HTFFM-05), which was organized by the Institute of Thermal-Fluid Dynamics of ENEA in the frame of the Engineering Conferences International, was held at Castelvecchio Pascoli (Barga, Lucca) during September 25–30, 2005. A total of 84 participants attended the Conference and about 60 papers were presented in oral plenary sessions besides seven keynote lectures. The papers have covered single-phase fluid flow and heat transfer, adiabatic two-phase flow, flow boiling, phase change, condensation, heat exchangers, measurement techniques, MEMS, microfluidic systems and devices, all of which are of current scientific and technological interest.

This Conference followed a similar conference organized by ENEA and ECI in Banff, 2000, so a comment can be made on the progress since then. We may say that until 2000 the research in microscale, especially on heat transfer and fluid flow, was rather immature without fundamental knowledge on the physical and chemical mechanisms involved as well as adequate measurement techniques even for very reduced geometric models such as circular pipe and plane channel. An example was the measurement of micro channel diameter, surface roughness, pressure drop, and wall temperature, which has to be made against extreme difficulty to avoid large uncertainty in the evaluation of fluid velocity, friction factor, and heat transfer coefficient. A contradictory trend existed in similar tests conducted in different laboratories, evidencing a large discrepancy with the traditional theories, and this was mainly due to experimental uncertainty and inadequate instrumentation.

After five years, a main conclusion from HTFFM-05 is that, at least for single-phase fluid flow (gas or liquid), the higher test accuracy and the larger availability of more adequate measurement techniques have led to a convergence of similar experimental results and to general verification of existing theories valid for macroscale. However, we still need to be cautious for single-phase heat transfer, where the uncertainty associated with wall temperature and the effect of conjugate heat transfer prevent a general comprehension of the phenomenon. Two-phase flows, both adiabatic and with phase change, exhibit complex behavior. Experimental results look fairly consistent, but available predictive tools are far from being adequate. This is by all means due to the complexity of two-phase flows with different flow patterns and bubble dynamics in microscale. Clearly, an accurate characterization of two-phase flow in microchannels is required along with improvement of predictive tools (if not necessary to have new ones), which currently rely on the empirical-experimental basis.

This issue of IJHFF contains revised versions of 12 selected papers representing the Conference, thus providing the reader with the latest findings on the topics such as single-phase heat transfer w/o variable fluid properties, rarefied/compressible gas flows, convective boiling, numerical simulation, and measurement techniques.

We wish to thank all participants for making HTFFM-05 very successful in progressing the state-of-the-art in heat transfer and fluid flow in microscale.

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