Editorial

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The special issue of *Progress in Computational Fluid Dynamics* (PCFD) brings together selected papers from the International Conference on Computational Heat and Mass Transfer held in Paris 17–20 May 2005 (ICCHMT 05). The conference is covering a relative broad spectrum of topics, ranging from applied mathematics and the computational analysis to various applications and design optimisation. It is a rapidly evolving research field, as well as an irreplaceable design tool in modern engineering practice.

We would like to express our gratitude to the PCFD Editor, Professor A.C. Benim, for dedicating a special issue of this journal to high quality papers presented in the ICCHMT 05 conference. The ten contributions are selected from the three hundred presented papers.

The objective of the meeting was to address the state of the art on the CFD-CHMT interaction in several domains involving developers of model, tools, and to focus on some specific applications. A large work is devoted to complex systems and coupled heat and mass transfer, the latter including also air quality and pollutant transport. We note also a new point of interest centred on microfluidic and on molecular and lattice Boltzmann methods with applications related to various scales.

The computational fluid dynamics and the computational heat transfer dealing with the transport phenomena appeared to be in exponential growth. The complex local treatment is supported by the huge computer power ability. In close future the continuous modelling from local to global size will be possible by using heterogeneous and hybrid approach (coupling: Finite Volumes, Finite Elements, Boundary Elements, spectral, Lattice-Boltzmann, Molecular Dynamic). Such processes involving fluid flow, heat and mass transport are encountered in very diverse fields, such as chemistry, biomedical, biochemistry, engineering, botany, geology, and medicine. Specific practical examples of engineering interest abound, including metallurgical process, powder and drug delivery systems, chemical reactors, filters, leaf transpiration and cropping, nuclear waste disposal, underground pollutant transport, oil/gas recovery, building insulation, alveolar respiration and capillary circulation, among many others. The several processes are involved as the main phenomena by those studying transport phenomena in materials, the vastness of the applicative field is also a weakness for hindering the development of uniform community, theories and standards. The state-of-the-art, trends and perspectives in the few fields are overviewed by the selected papers, given by internationally recognised research group.

The present issue is dedicated to complex coupled non-linear problem dealing with the solid-liquid phase change (papers 1 and 2) where the natural convection, and the mixed convection (rotation) and the surface tension effects control and impose the resulting heat and mass transfer and the flow structure. The dynamic behaviour remain one of the challenges in the flow stability treatment, a high order scheme and accurate integral approximation is used to analyse the unsteady natural convection effect (as presented in papers 3 and 4). It is followed by a mixed convection problems analysis (papers 5 and 6) induced classically by imposed flow or by cylinder rotation.

The humidity or cross effects (as Thermodifusion) are generally considered as minor effects and neglected in heat and/or mass transfer. It is pointed that under specifically conditions, such effects modify the stability limit or the transition from laminar to turbulent flow (as presented in papers 7 and 8). Other interesting problems with a real challenge are those dealing with small-scales (micro or nano). The issue is completed by the small size droplet evaporation on substrate and another complex problem of nanopowder synthesis involving chemical heat surface tension or turbulent coupling phenomena (papers 9 and 10).

We hope that the volume provides an overview of the state-of-the-art of chosen topics in heat and mass transfer and will thus serve to many readers from academic and industrial communities as an up-to-date source of information, as well as a useful support for further research.