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Editorial

Boiling of pure liquids and of liquid mixtures is an essential basic operation of Thermal Sciences, and has been intensively explored during the last decades. Nevertheless we are still far from having a complete theory because the physical phenomena are too complex and not sufficiently well understood. There are still many gaps in our present knowledge.

As a matter of fact the many correlations to predict heat transfer coefficients are based on a great number of experiments with many technical relevant substances, but they can hardly be extrapolated to other substances or thermodynamic states than in the underlying experiments.

The following contributions report on results of a joint research program aiming at improving the existing models of heat transfer in nucleate boiling of pure substances in a wide range of pressure and temperature. Special emphasis was laid on exploring the interaction between the microstructure of the heating surface, the mechanism of bubble formation and heat transfer, which up-to-date is not well understood. The results obtained should serve as a basis to develop evaporators of high performance, saving energy and material in comparison to existing design.

The concept of the research program was outlined during a Eurotherm–Seminar organized by the Thermodynamics and Heat Transfer Section of the University of Paderborn, Germany, in 1996. As a result of this meeting 12 projects from a total of 24 projects were considered as appropriate and coherent to achieve the objectives of the joint research program.

After submission of the projects to the German Research Foundation (DFG) the referees of the DFG recommended acceptance of 8 projects, which they evaluated as well suited to guarantee a good synergy between the proposals right from the beginning on. These 8 projects were funded by the DFG from 1998 to 2003 with around 1 Million EUR annually. After the first two years the DFG funded in addition for two central service projects: A digital high-speed video-system with 1000 frames/s and high local resolution, and a device furnished with a pressure chamber, to determine contact angles of vapour bubbles up to pressures of 3 MPa.

Those who took part in the joint program were scientists of longstanding experience in the field of pool boiling heat transfer.

In a cooperative effort scientists of the Universities of Stuttgart and Paderborn did experimental research on heat transfer, bubble formation and surface roughness, those of the Universities of Berlin and Munich concentrated on measuring techniques in heat transfer and vapour production, and another group of Stuttgart University worked on modelling heat transfer taking into account the interaction between wall and fluid. These groups of the four universities Berlin, Munich, Stuttgart and Paderborn were effectively supported by experts of closely related disciplines of two more universities: Experts of the Institute of Process Systems Engineering of the University of Aachen (RWTH Aachen), Germany, and experts of Institute of Chain Pattern and Recognition of the University of Freiburg, Germany. The research at Aachen University aimed at developing a dynamic mechanistic model of boiling processes, supported by experiments. The Freiburg group generated a semi-automatic system to identify nucleation sites by backward tracking of rising bubbles.

The following reports present the main results of these projects. We consider them as a contribution to a better understanding of boiling processes, but nevertheless are aware that many questions are still open. Thus we sincerely hope that the results will stimulate future research in the field.

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