DESCRIPTION FOR THE GENERAL PUBLIC

Ongoing advancement of technology and IT revolution are major factors in the growth of energy demand combined with the tendency for miniaturisation of modern devices. The power supply and cooling of electronic components necessitate continuous improvement in product energy efficiency. Vitally important areas of industry, energy, automotive, chemical engineering and others are directly dependent on ever more efficient heat exchangers. One of the most effective cooling methods is the use of heat transfer processes with the change of state (boiling). Methods capable of heat transfer intensification through e.g. increase in heat transfer surface area are currently being sought. Each solution has to be thoroughly studied as the application of enhanced surfaces to cooling compact devices (e.g. microprocessor, high power integrated circuits) or for energy sector (e.g. in gas turbine-based heat and power plants) is highly desirable due to the additional heat dissipation. Heat transfer with the use of systems with a group micro- and minichannels is common for its potential for transferring large heat fluxes and for its ability to meet conflicting requirements, i.e., obtaining highest possible heat fluxes at small temperature difference between the heated surface and the saturated liquid at small sizes of heat transfer systems. Therefore, miniaturization and high thermal efficiency can be compatible through the use of two-phase flow phenomena in boiling in micro- and minichannels.

The primary objective of this project is analysis of heat transfer during two-phase flow along a group of micro- and minichannels. Other objectives include determining the influence of heated surface enhancement and the test section position on the development of boiling and the flow resistance, and the influence of selected heat and geometric parameters (pressure and flow rate), geometries of the micro- and minichannels and the refrigerant type on the boiling mechanism in the channel. Analysis covers the issues of refrigerant pressure instability during flow boiling that may disturb heat exchangers operation. A compact experimental setup with a removable test section with a group of micro- and minichannel (Fig. 1) is used in the study. Temperature of the heated wall with channels is measured with the aid of an infrared camera. A high-speed camera for simultaneous acquisition of two-phase flow patterns in channels is applied.

Recent publications are mainly analytical-numerical studies of heat transfer problems, with experimental part abandoned. But mathematical analyses and numerical procedures should be based on experimental results for both approaches to be complementary. Various computational methods are used in this study: transform methods, original analytical-numerical and numerical techniques applied with the aid of commercially available, recognized software to verify the correctness of computation and feasibility of the methods. The expected outcome of the project will be a mathematical model for two-phase flow boiling heat transfer in a group of micro- and minichannels, a model of boiling development, and the proposal of original correlations designed to predict heat transfer enhancement. The results will help determine the highest effectiveness of boiling heat transfer during the flow of refrigerants along micro- and minichannels.

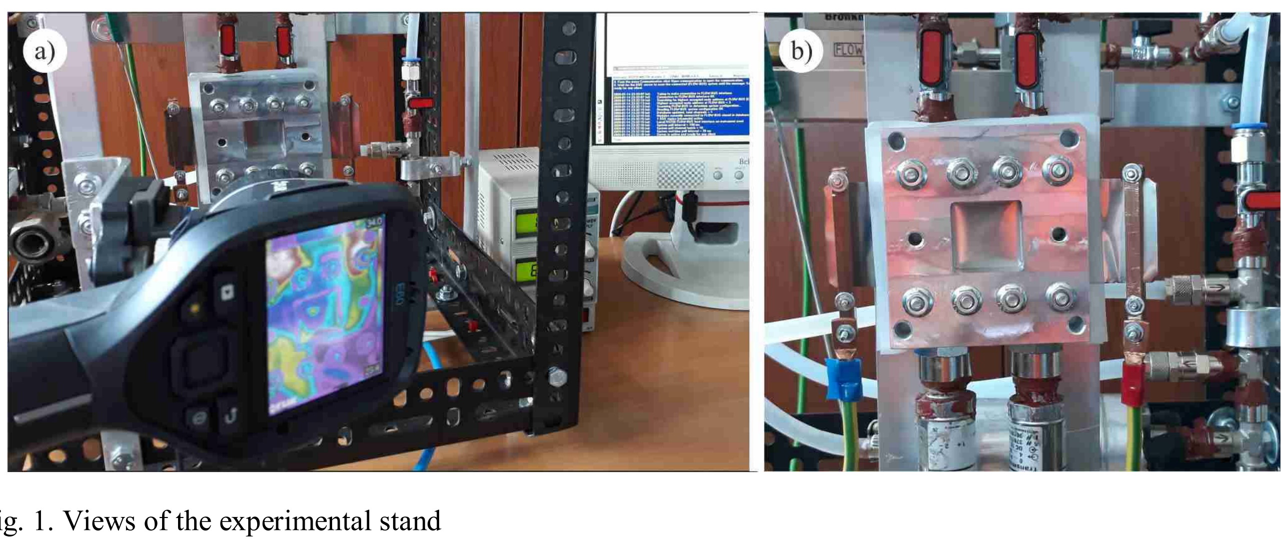

Fig. 1. Views of the experimental stand