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Author: Dariusz Chojiński, Artur Wodołański, Piotr Skupin, Dariusz Stachańczyk, Małgorzata Niedźwiedź

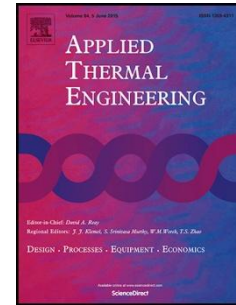
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Analysis of the thermal properties of a heat flow chip calorimeter using CFD

Dariusz Choiński, Artur Wodolazski, Piotr Skupin*, Dariusz Stachanczyk,
Małgorzata Niedzwiedz

Faculty of Automatic, Electronics and Computer Science Control
Silesian University of Technology
ul.Akademicka 16, 44-100 Gliwice, Poland

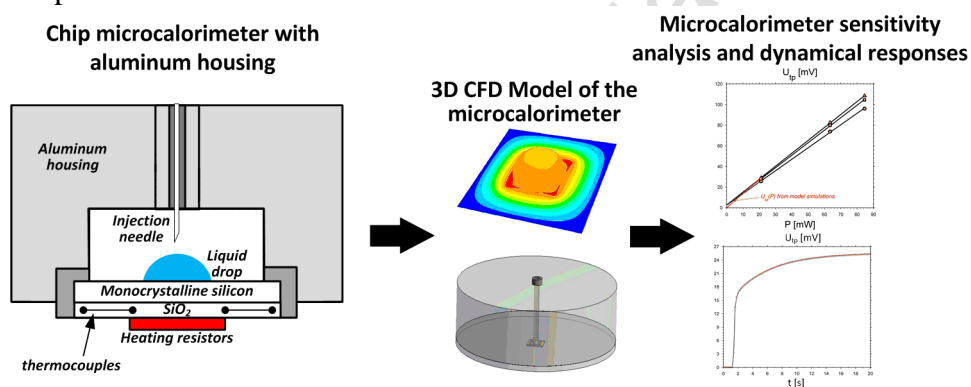
{dariusz.choinski, artur.wodolazski, piotr.skupin, dariusz.stachanczyk,
malgorzata.niedzwiedz}@polsl.pl

*Corresponding author: Piotr Skupin (piotr.skupin@polsl.pl)

Highlights:

- The CFD model of the membrane heat flow calorimeter for liquid samples is proposed.
- We analyze the temperature and heat flow distribution in the chip calorimeter.
- We present a calibration procedure for the CFD model of a commercial calorimeter.
- The influence of the membrane thickness on the calorimeter sensitivity is analyzed.
- Static and dynamic properties of the calorimeter set-up are described.

Graphical Abstract



Abstract: The possibility of using a membrane chip calorimeter as an on-line measurement instrument depends on the condition that the calorimeter's characteristics is linear in the measuring range of flow rates. This condition is met when the heat conduction is considered only in the plane of the calorimeter membrane and the heat losses in other directions are assumed to be constant. The studies involving a 3D model of the commercial chip calorimeter were focused on the determination of a linear operating range of the calorimeter. To study the calorimeter properties a Computational Fluid Dynamics model of the calorimeter set-up has been developed using the ANSYS Fluent software. The CFD model has been calibrated for the calorimeter with an empty membrane, and then validated against the measured data for the calorimeter with a liquid sample on its membrane. Based on the measurement and simulated data, the static characteristic of the calorimeter and its properties has been determined. It was also possible to analyze the dynamical behavior of the system. The simulation results revealed a large variation in the dynamical properties of the calorimeter in the case of step changes in the heating power.

Key words: CFD model, heat flow calorimeter, microcalorimeter, NCM-9924

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