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METHODS AND TOOLS FOR CHARACTERIZATION OF THERMOCHEMICAL STORAGES

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INTRODUCTION

The demand of more powerful heat storage materials is rising in various industrial sectors. For example the performance of electronic devices is increasing on every stage of development and proceeding miniaturization. To prevent possible overheating of these components, heat storage (e.g. thermochemical or phase change materials) can be used in addition to the existing active cooling systems to reduce peak temperatures in extreme performance situations. It is difficult to characterize the most important characteristics heat capacity and heat conduction, since a superposition of these two properties usually occurs in the application. For a better illustration of these effects numerical methods are frequently used.

METHODS

For the identification and subsequent characterization of novel heat storage materials, the use of different measurement and analytical methods is necessary. Calorimetric methods (e.g. DSC) are used, which provide information about the reaction enthalpy and the reversibility of the system. The most important material property is the thermal conductivity, which is measured with a hot-disk device (Fig. 1).

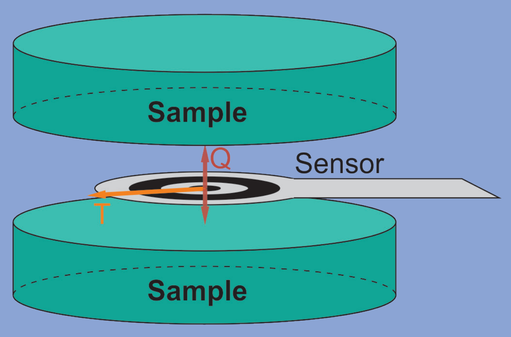

Fig. 1: Sketch of the Hot-Disk system

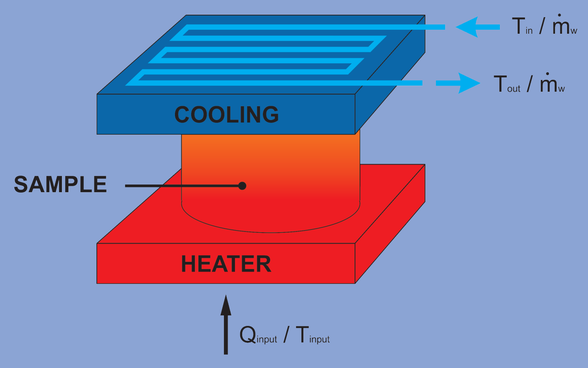

Fig. 2: Sketch of the measurement apparatus

In order to test heat storage materials under realistic conditions in small-scale, additionally a special apparatus was developed (Fig. 2). With this measuring apparatus, whose main components are an accurate temperature measurement and an adjustable heating element (constant temperature rise and power input), important characteristics of the heat storage material can be determined for a complete description of the system under dynamic conditions.

SIMULATION

For a variety of materials it is possible to achieve good results with the presented equipment concerning the material properties. The experimental data can be used in numerical simulations to calibrate simulation models. Afterwards the model can be used to simulate the dynamic memory behavior of a material in case of actual use.

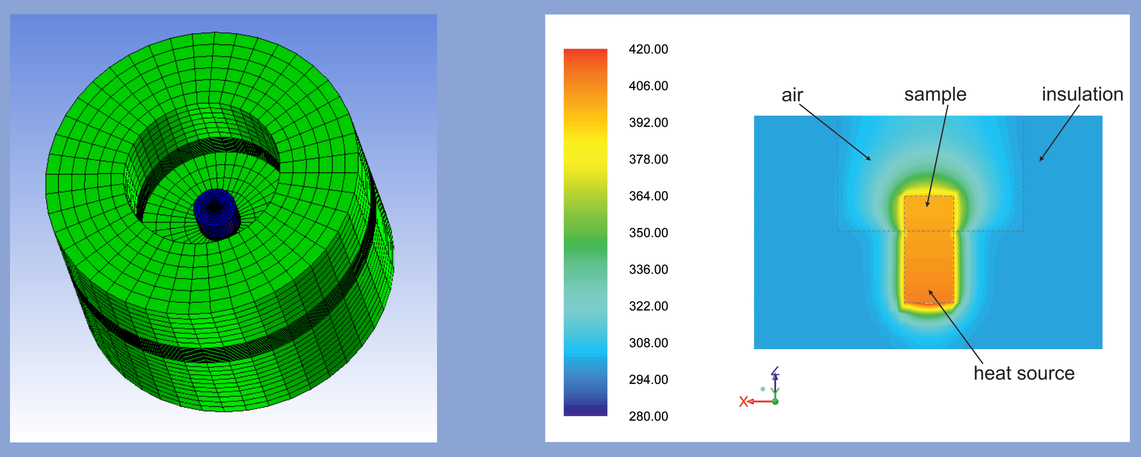

Fig. 3: Computation grid (left) / temperature contour of the apparatus (right)

A satisfactory agreement between the numerical investigation and the experimental data was obtained with two different latent heat storage materials (Fig. 4).

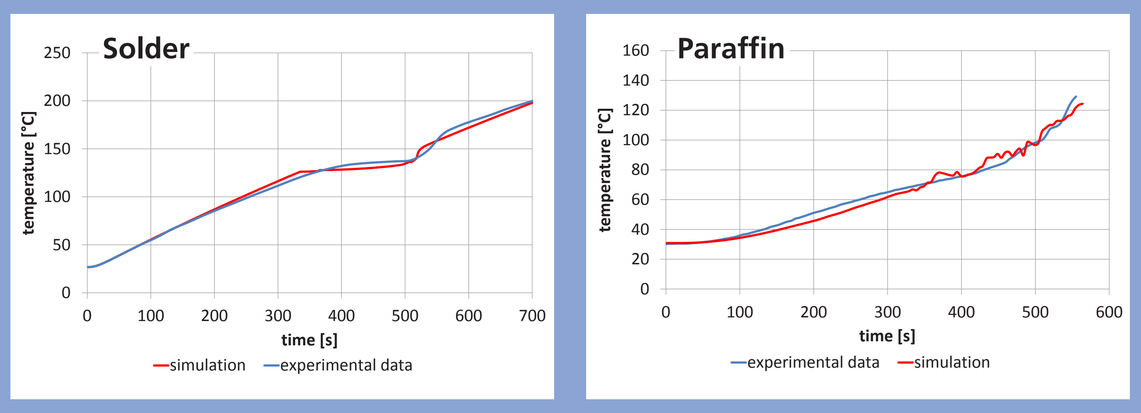

Fig. 4: Comparison of the temperature profile of the measuring apparatus and the simulation

In the following steps the model can be used for other geometries. In Fig. 5 the simplified model of a circuit board with an additional phase change heat storage is compared with a conventional board.

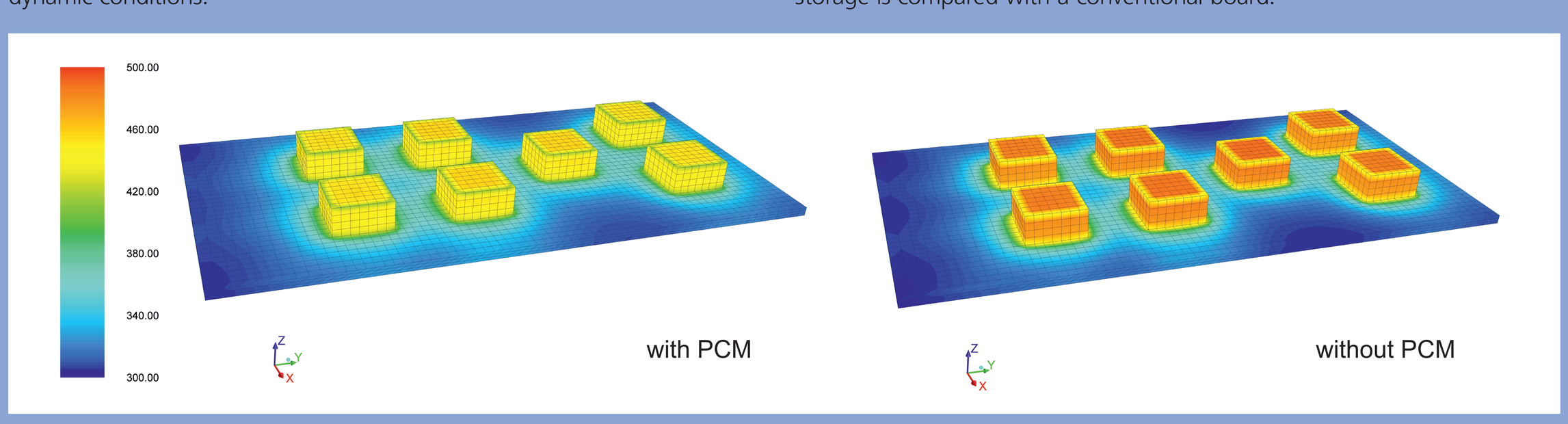

Fig. 5: Comparison of the temperature contour of a circuit board with an additional phase change heat storage (left) and a conventional board (right)