Solutions to dedicated problems of contact less material parameter and thermal measurements

Summary

The thesis presents new methodologies for the solutions of dedicated problems of material parameter investigations and thermal measurements.

The first chapter of the work presents a new methodology for the mapping of surface potential. A detailed presentation is given about the computer controlled surface potential measurement system. In this measurement method the signal/noise ratio degrades significantly as a result of using very small size reference electrodes. The chapter presents the new procedure developed to improve the accuracy of the measurement.

The second chapter gives an overview of the theoretical background of the time and frequency domain descriptions of the thermal behavior of real physical systems. This theoretical summary is needed to understand the subsequent chapters dealing with thermal modeling. The results presented here are not claimed new results of the thesis work, they serve only as background to the understanding of the next chapters and for the presentation of the state-of-the-art.

The third chapter of the thesis work deals with the multiport thermal modeling of integrated circuit packages. A new methodology is presented that has been elaborated to enable determining thermal transfer impedances between the integrated circuit chip within the package and the thermal port defined on the surface of the package. The methodology uses infrared sensor measurements and laser excitation of the surface. With the help of the new methodology parameters of compact models of the thermal behavior of integrated circuit packages can be determined.

The fourth chapter deals with the questions of measuring a frequently used approximated value, the effective thermal conductivity of printing circuit boards. The chapter presents the simulation and measurement experiments on one and two sided printed wiring boards and defines methodologies for determining the effective thermal conductivity coefficient based on structure function measurements, and for measuring effective heat conductivity parameters with the help of infrared camera measurements.

The fifth chapter of the thesis work presents a methodology to measure the volumetric temperature distribution resulting from microwave excitation in an industrial environment. Microwave heating assures an exceptional opportunity for the processing of matter, as heating occurs with volumetric excitation. In the industrial environment the electromagnetic field is inhomogeneous, resulting in temperature differences within the volume, which are especially significant in case of small thermal conductivity materials. The chapter presents a methodology developed for the experimental verification of the approximate volumetric thermal distribution of low thermal conductivity matter. With the help of the new methodology the physical processes in the pharmaceutical industry became much better controllable than before.