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Droplet-Based „Digital“ Microfluidic Systems: Computer-Aided Design, Testing and Applications

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Abstract

Composite microsystems that incorporate microelectromechanical and microfluidic systems are fast emerging as the next generation of system-on-chip (SOC) designs. The combination of microelectronics and microstructures is enabling a new class of integrated systems targeted at enviornmental sensing, actuation and control, biomedial analysis, agent detection, and precision fluid dispensing. The 2001 International Technology Roadmap for Semiconductors (ITRS) identifies the integration of electro-chemical and electro-biological MEFS as one of the system-level design challenges that will be faced beyond 2007, when feature sizes shrink below 65nm. Microfluidics allows us to control small amounts of fluids for precision dispensing (micro-dosing) and reduce reagent consumption for on-line chemical analysis and real-time process monitoring. By scaling down the concentration of chemical samples, simpler sensing techniques can be utilized to replace costly practices involving batch analysis, sample pre-treatment, and frequent calibration. In this talk, I will first present an overview of the droplet-based digital microfluidics technology developed at Duke University. I will then address the problem of designing droplet-based biochips. Current techniques for full-custom design of droplet-based „digital“ biochips do not scale well for concurrent assays and for next-generation SOC designs that are expected to include fluidic components. I will describe a system design methodology that attempts to apply classical architectural-level synthesis techniques to the design of digital microfluidics-based biochips. A clinical diagnostic procedure, namely multiplexed in-vitro diagnostics on human physiological fluids, will be used to evaluate the proposed method. Next, I will present a concurrent testing methodology for detecting catastrophic faults in droplet-based microfluidic systems and address the related problems of test planning and resource optimization. The proposed approach is directed at ensuring high reliability and availability of bio-MEMS and lab-on-a-chip systems, as they are increasingly deployed for safety-critical applications. Finally, time permitting, I will describe our recent work on chip cooling using droplet-based microfluidics.

Gastgeber: Prof. Dr. Bernd Becker

Alle Interessenten sind recht herzlich eingeladen.

Organisation : Prof. Dr. B. Becker / F. Schmiedle

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