Mixed-Mode Device-Circuit Simulation of Thermal-Based Microsensors

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The transient thermal behavior, circuit transient response, and system behavior under transient flow conditions are presented for a microflow sensor integrated with control circuitry for constant temperature operation. The simulations of the sensor, which take into account electrothermal coupling, the cointegrated circuitry, and sensor-circuit interactions, are all performed within the framework of a VLSI environment. The approach differs from other mixed-mode simulation strategies in that the central environment is the circuit simulator.

1.   Introduction

Support electronics has become an essential part of silicon-based microtransducers, providing pertinent control and signal processing/conversion functions for improved accuracy, reliability, and functionality.[1] Integration of all these elements, preferably on a single chip,[2] constitutes the first step towards realization of 'smart sensors' and microsystems. To facilitate efficient design of the transducer and support circuitry, adequate simulation tools are needed which can concurrently meet the design requirements for reliable operation of both device and circuitry. In particular, it is crucial that the simulation tool or environment take into account device-circuit interactions as well as provide self-consistent numerical solutions for both the sensor and circuitry.

The above requirements can, for example, be addressed with mixed-mode or merged