Novel Temperature Controlled Silicone Flow Cell for Portable Biosensors

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A novel design of a temperature-controlled molded silicone flow cell is presented. A single piece of molded silicone rubber mates to an array of eight Texas Instruments Spreeta sensors. The Spreeta sensors are incorporated into a sensing cartridge that is used in a portable biosensor called SPIRIT (Surface Plasmon Instrumentation for Rapid Identification of Toxins) being developed at the University of Washington.

The silicone flow cell is formed in a Delrin mold machine using a computer-controlled mill. The mold defines eight separate flow regions (one for each sensor). Fluidic channels connecting these regions are formed by threading tapered fly-fishing leaders between holes in the mold prior to molding. After the mold is filled with PDMS and cured, the tapered leaders are removed, leaving eight interconnected flow regions in a single piece of silicone.

Temperature control is important in surface plasmon resonance detection because temperature changes during an assay will introduce drift. Throughout a sequence of measurements, the sensor temperature must remain steady regardless of changes in ambient temperature. To provide this stability, the molded silicone flow cell seats into an aluminum backer constructed to index precisely against the sensor array. The temperature of the backer is regulated using a Peltier Thermal Electric cooler driven by an analog Proportional-Integral-Derivative control circuit. For minimum power consumption, the regulation set point is set to ambient temperature. Experimental results characterizing regulation under various conditions are presented.