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Abstract
The design and fabrication of a thermal system with voltage regulated micro heaters are presented. The thermal system is intended to provide stable heat sources to the polymerase chain reaction (PCR) system. This study is concentrated on (i) the design, fabrication and test of micro heaters, (ii) the circuit design and control of power supply for heaters, (iii) the fabrication and control of a rotary mechanism, and (iv) the fabrication of a reaction well.
By using the micro-electro-mechanical-system (MEMS) technology, micro heaters are fabricated on a microscope slide. The temperature of heaters is then adjusted by a voltage regulator. The variation of heater temperature with time is measured and recorded by a homemade data acquisition system consisting of K-type thermocouple, LabVIEW7.1 software, and NI USB-9211 data acquisition card. Results show that the stability of micro heaters is very good and the maximum temperature deviation is within 1°C. The thermal cycling system is further implemented with a rotary mechanism. The signal and operation of the mechanism are controlled by LabVIEW7.1 software and NI USB-6009 data acquisition card.
Three micro heaters are used to build up three temperatures that PCR needs. The sample is then rotated by the mechanism to contact with the micro heaters of different temperatures so that it achieves the required temperatures via heat conduction. A new PCR system is successfully developed in this study.
The sample temperature in the reaction well of the thermal cycling system rises at a rate of 1°C/sec and drops at 2.8 °C/sec. The rise rate is slower than that of the traditional PCR because there is a thermal resistance between the micro-heaters and reaction well as heat transferred by conduction. The problem is worth studying further.
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