

Biomedical Diagnostics Institute

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***Thermal control for nucleic-acid amplification based
microfluidic devices***

Rapid detection and precise identification of bacterial pathogens is critical in food and water monitoring and in clinical diagnostics. Detection becomes more challenging because of the low concentration of pathogens (10 – 100) in large-volume samples. Traditional techniques such as visual microscopy, plating, or culture enrichment can require times on the order of days, require access to unique facilities (bio-hazard containment), and need skilled technicians who may have to perform many repetitive steps.

We are developing an automatic miniature system that could solve most of these problems. This miniature system would require minimal handling by an operator and ideally could be able to be used by non-trained users. The system fits into a compact disk and fluid handling and manipulation of different tasks is accomplished using a brushless DC motor. The system comprises different microfluidic modules: a sample-collection unit to concentrate the pathogens; a lysis unit to burst the pathogens and release the nucleic-acid; and a nucleic-acid amplification unit to replicate the nucleic acid. The amplification requires precise temperature control to work adequately.

This project will focus on the nucleic-acid amplification unit. This unit replicates ribonucleic acid (RNA) after it has been extracted from the pathogen, and it's a core part of the full integrated system. The reaction requires precise temperature control. As part of this project you will be involved in the design and test of the temperature control module. Heat generation will be accomplished using thin-film electric heaters patterned on a plastic substrate. To monitor the temperature you will use different sensors such as thermocouples and RTDs. In addition, you will use LabView and National Instruments electronic interface cards or a microcontroller to control the heater and monitor the sensor. In addition, you'll also design, fabricate, and test different microfluidic modules.

If you want to know more about microfluidics and our project you can consult the following material:

The origin and future of microfluidics, George Whitesides

<http://www.nature.com/nature/journal/v442/n7101/abs/nature05058.html>

Total nucleic acid analysis integrated on microfluidic devices, Lin Chen *et al*

<http://www.rsc.org/Publishing/Journals/LC/article.asp?doi=b708362a>