A175 Towards the Development of a Single Microfluidic Device for DNA Extraction using Magnetic Particles and Non-Contact IR-Mediated PCR for STR Analysis

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After attending this presentation, attendees will have learned about the development of a microfluidic device that combines solid phase extraction using magnetic particles with infrared - mediated PCR amplification of DNA for STR analysis.

This presentation will impact the forensic community by presenting work that represents a major step towards the development of a fully integrated microdevice capable of total DNA analysis for forensic casework.

The proven utility of forensic DNA evidence has increased the demand for DNA analysis services. Although conventional analysis techniques are effective, they are time consuming and laborious, which has contributed to an overwhelming backlog of forensic casework samples with possible biological evidence. Microchip technology offers the potential of a rapid, cost-effective alternative to conventional DNA analysis methods. Microdevices provide self-contained, closed systems for analysis procedures, diminishing the potential for contamination or loss of sample. In addition, the use of microchips offers a reduction in required sample volume, which could potentially allow for the analysis of casework not amenable to conventional procedures. Techniques performed on microchips are particularly advantageous because they can be integrated with upstream or downstream analytical steps on a single microfluidic device in the form of a lab-on-a-chip. These integrated microfluidic systems, which incorporate all of the sample processing steps required for DNA analysis, will reduce analysis times, and therefore, the forensic casework backlog.

Successful integration of microchip packed bed solid phase extraction (SPE) and infrared-mediated (IR-mediated) PCR – two of the procedures necessary for forensic genetic analysis of crude biological samples – has previously been demonstrated by our laboratory.[1, 2] Recently, an alternative microchip SPE method (ωSPE) has been developed that utilizes commercially available paramagnetic particles. An external magnet is used to control the location of the particles in a microfabricated chamber, removing the need for etching structures (such as weirs or pillars) into the channels, and increasing the simplicity of device design and fabrication. The ωSPE technique provides similar or better extraction efficiencies and increased capacity compared to packed bed microchip SPE techniques. In addition, ωSPE allows for user-defined fluidic control, eliminating carryover from incompatible SPE reagents (chaotropic salt or organic wash solvents) that would inhibit subsequent PCR amplification – a particular challenge in the integration of microchip SPE and PCR.

The research presented will highlight the development of integrated microdevices that combine solid phase extraction using magnetic particles (ωSPE) with infrared-mediated PCR (IR-PCR) amplification of the purified DNA. The functionalities of the device are described, including the results of separations of the STR fragments from genomic DNA isolated and amplified using the integrated device. The presented work represents a major step towards the development of a fully integrated microdevice capable of total DNA analysis for forensic casework.

References:

1. Legendre, L.; Bienvenue, J.; Roper, M.; Ferrance, J.; Landers, J., A valveless microfluidic sample preparation device for DNA extraction and amplification using conventional instrumentation. *Anal Chem* **2006,** 78, 1444-51.
2. Bienvenue, J.; Legendre, L.; Ferrance, J.; Landers, J. In *Integrated DNA extraction and PCR amplification of STRs: interfacing microfluidic devices with current methodologies and conventional instrumentation*, American Academy of Forensic Sciences 59th Annual Scientific Meeting, San Antonio, TX, 2007; San Antonio, TX, 2007.

DNA Extraction, PCR, Microchip

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