

STR FRAGMENT SEPARATION AND ANALYSIS BY PLASTIC CHIP ELECTROPHORESIS: MODULE DEVELOPMENT FOR AN INTEGRATED STR TYPING SYSTEM*

Allison Phayre, Mrinalini Prasad, Stanley Smith, Darryl Cox, Qihuo Wei, Venkata Kelam, Ralf Lenigk, Joel Dudley[‡], Sudhir Kumar[‡], Carl Yamashiro, Frederic Zenhausern

Center for Applied Nanobioscience, Biodesign Institute, Arizona State University,
Tempe, AZ, 85287-5101

[‡]Center for Evolutionary Functional Genomics, Biodesign Institute, Arizona State University,
Tempe, AZ 85287-5001

The large backlog of samples for forensic DNA STR typing has resulted in a need for faster, more efficient, and cheaper analysis systems which will eliminate the backlog and result in a more streamlined process for STR typing. Some considerations for such a system are decreased reagent and sample consumption, decreased analysis time, protocol integration, and a disposable, cost effective platform. A microfluidic platform is the natural solution. By integrating DNA extraction, quantitation, amplification (PCR), and analysis (capillary electrophoresis) into one microfluidic cartridge, significant reductions in reagent and sample consumption can be achieved, and the protocol can be integrated to reduce the amount of hands-on manipulation. Fabricating such an integrated microfluidic system in plastic provides a disposable and more functional device which minimizes user intervention. In order to develop such a system, each step of the STR typing protocol must be engineered for a microfluidic platform and tested individually in microfluidic modules. After satisfactory performance has been achieved, the modules can then be combined into one integrated microfluidic cartridge which will perform all of the functions necessary for STR typing.

Here we focus on the development and testing of the analysis module. The design, testing, and fabrication of plastic electrophoresis chips for STR fragment analysis will be presented. Separation of STR loci is demonstrated in chip electrophoresis devices with three orders of magnitude less sample injected and analysis times of only a few minutes. Deconvolution software developed in-house is used to separate the five dyes' spectral signals for unique loci identification, and a local Southern method is used to identify peaks. Alleles are assigned by the software through comparison to the simultaneous size standard separation. The first steps toward a fully integrated microfluidic STR typing cartridge are also presented: results from an integrated PCR/CE device which allows the reproducible injection of small amounts of PCR product into the electrophoresis channels for separation and analysis will be shown.

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