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DEVELOPMENT OF A FULLY AUTOMATED PROCESSING CARTRIDGE FOR THE STR-TYPING OF SEXUAL ASSAULT SAMPLES*

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The STR-typing process is broadly used in molecular forensic analyses, including sexual assault case samples, to specifically identify involved individuals. To further simplify the implementation of this process, it is desirable to use advances in microfluidics technology and system engineering to build a platform that involves fully integrated disposable cartridges which can be used by minimally trained operators and increase throughput capabilities with greater reproducibility of the test. Instrument prototype modules and disposable cartridges for the automated processing of sexual assault samples were developed and tested using mixtures of sperm and epithelial cells. The final instrument will integrate and automate the differential extraction process, quantification of the extracted DNA, PCR amplification, capillary electrophoresis, multi-color detection and STR genotyping. The system was designed to use commercially available reagents, Identifiler™ and Quantifiler™ from Applied Biosystems. In this presentation we report the data for the yield of the DNA extraction process, the efficiency of epithelial and sperm DNA separation, the DNA quantification results, the sensitivity of the CE system, and the in-house developed STR genotyping software. The processes have been completely automated, using an electronic interface to control the instrument. We have developed injection molding processes to enable large volume fabrication of the disposable STR-typing plastic cartridges. The developed process allows us to combine the fabrication of sample preparation microfluidic components with volumes in the hundreds of microliters with that of small-scale dimensions for capillary electrophoresis channels with a width of less than 100 µm. The feasibility of performing an automated STR-typing process on such integrated all-polymer microfluidic system was demonstrated, establishing the possibility of building a reliable low to medium throughput, low cost and easy to use system. * This work was supported by the U.S. Department of Justice, Federal Bureau of Investigation under contract J-FBI-03-085. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.