INEXPENSIVE AND HIGHLY PORTABLE ROTATIONALLY-DRIVEN MICRODEVICE FOR FORENSIC DNA SEPARATION

[1]Daniel A. Nelson, [1]An-Chi Tsuei, [1]Brandon L. Thompson, [1]Christopher Birch, [1]Jingyi Li, [1]Delphine Le Roux, [1]Jacquelyn A. Duvall, [4]Brian E. Root, [1,2,3]James P. Landers

[1]Department of Chemistry; [2]Department of Mechanical Engineering; [3]Department of Pathology; [4]Applied Research Institute; University of Virginia, Charlottesville, VA, USA 22905

The conventional method of forensic DNA analysis is a labor-intensive, time-consuming process requiring highly skilled personnel and dedicated instruments that are not portable. Moreover, Rapid DNA systems have been developed and released, and while portable, they are large and expensive. There is a need for the development of an inexpensive, rapid and portable device for STR fragment separation in forensic DNA analysis. To meet these needs, we report progress towards the development of a unique, multi-layer, rotationally-driven microdevice (RDM) fabricated using a simple process, common equipment and an inexpensive substrate.

With the goal of generating an inexpensive electrophoretic microdevice, we demonstrate the fabrication of an RDM from inexpensive materials such as polyester film (PE), pressure sensitive adhesive (PSA), and other proprietary substrates not typically used in microfluidics. Through a CAD design program, an RDM was designed with four electrophoretic separation domains that could be actuated on a rotationally-driven platform roughly the size of a compact disc. CO_2 laser ablation of each layer created intricate fluidic channels for DNA electrophoresis with features less than 100 µm. Once each layer was laser cut and appropriately prepared for bonding, they were bonded using a simple office laminator. Separations in devices fabricated with various combinations of materials show the potential of this platform with a separation of DNA fragment ladder at a resolution of 0.56 up to 200 bp, and 0.33 up to 300 bp in a 4 cm separation. This has potential for integration with upstream sample preparation and PCR for rapid human identification/screening in the field.