

Integrated Portable Genetic Analysis Biosystem

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A portable forensic genetic analysis system consisting of a microfluidic device for amplification and separation of short tandem repeat (STR) fragments as well as an instrument for chip operation and four-color fluorescence detection has been developed. The microdevice performs polymerase chain reaction (PCR) in a 160-nL chamber and capillary electrophoresis (CE) in a 7-cm-long separation channel. The instrumental design integrates PCR thermal cycling, electrophoretic separation, pneumatic valve fluidic control, and 4-color laser excited fluorescence detection. For forensic human identification, a quadruplex Y-chromosome and nine multiplex autosomal STR typing system were developed and used for validation studies. All the amplicons can be detected with less than 100 copies of genomic standard DNA in the reactor. Real-world forensic analyses of oral swab and human bone extracts from case evidence were also successfully performed. To evaluate the capability of rapid point-of-analysis DNA typing of forensic casework, we mimicked crime scene where the DNA samples were extracted from blood stains on cloth and paper towel of victims and successfully identified the suspect and victims on the spot.