Simple Device for Improved DNA Concentration and Purification

Published date: May 14, 2019

Technology description

Microfluidic Device Uses Flow and Electric Fields to Concentrate DNA for Analysis and Sequencing

This device simultaneously concentrates and purifies genomic-length DNA samples from dilute solutions containing DNA, resulting in more efficient and cost-effective DNA analysis, testing, and sequencing. DNA diagnostics are commonly employed in forensics, testing of hereditary disorders, biological studies, and HIV detection. However, available DNA extraction methods have low efficacy levels in terms of isolating pure DNA material and additionally require costly instruments, such as a centrifuge, resulting in reduced accuracy in genetic testing and sequencing at a higher price. Researchers at the University of Florida have discovered a simplistic and cost-friendly microfluidic device that concentrates genomic-length DNA from dilute solutions at rates of upwards of 1,000 fold per minute, while also removing contaminants. This concentration and extraction device may be easily incorporated into DNA concentrator kits and biochip platforms for DNA analysis.

Technology

This microfluidic device utilizes an opposing pressure-driven flow and small electrophoretic velocity to concentrate DNA at one end of a microcapillary channel. The DNA first enters the microcapillary and stretches and aligns due to the strong pressure-driven flow. An electric field, simultaneously applied along the length of the capillary, acts on the polar nature of the DNA to generate a velocity toward the inlet as well as the bounding walls of the microfluidic channel. Once near the wall, the axial electrophoretic velocity exceeds the pressure-driven flow velocity and the DNA returns to the inlet of the microcapillary where it concentrates and can be collected for analysis. Under specific conditions, no DNA passes through the channel whereas other materials (particulates and macromolecules, even if electrophoretic) do pass through. Hence, the concentrated DNA sample is also purified.

Application area

Cost-effective device for the rapid extraction and concentration of long strands of DNA

Advantages

Device does not require use of expensive equipment or chemical reagents, improving overall cost-efficiency.
Simple microfluidic trap method reduces time necessary for DNA concentration and purification, improving lab turnover rate for DNA analysis.
DNA-specific separation technology allows for DNA to be concentrated and purified from nearly any solution, greatly improving versatility of device.

Institution

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