



New System Automates Workflow for 1-D Electrophoresis of Proteins and DNA

Introduction

The workflow for slab gel electrophoresis involves multiple manual steps that are difficult to automate. The use of pre-cast gels can accelerate the set-up process, but sample loading, gel running, staining, destaining, and data analysis remain slow, hands-on operations. To eliminate these bottlenecks, the LabChip 90 System incorporates automated sample introduction, microfluidic lab-on-a-chip electrophoresis, and real-time data reporting. The system was designed for laboratories that process 40 or more protein or DNA samples per day in microplates. Relative to traditional electrophoresis, the LabChip 90 system:

- Eliminates all manual sample handling and loading steps
- Eliminates manual staining/destaining, gel scanning and photo-documentation
- Provides faster, more accurate results
- Automatically provides digitized, quantified reports for easy export and archiving.

Principle of Operation

The LabChip 90 System is an automation platform that uses microfluidic electrophoresis chips (1). Samples from a microplate are automatically drawn onto the chip using vacuum-driven flow through the fused-silica capillary “sipper” (see Figure 1). Once on the chip, protein or DNA samples are driven through microchannels in the chip using electric fields. Size-based separations of protein or DNA samples are achieved by loading specific channels of the chip with a sieving polymer solution. Rapid separations can be performed because the microfluidic channels dissipate heat with extreme efficiency – very high electric fields can be used with no measurable heating. The separation media in these assays contain fluorescent stains that bind to protein or DNA molecules non-covalently. Sample peaks are detected as they pass through a laser spot in the chip’s detection window.

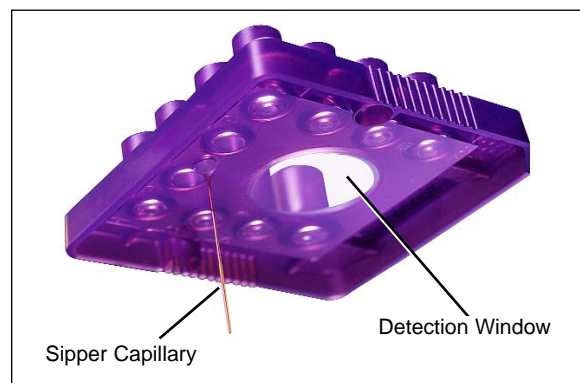


Figure 1. LabChip technology replaces multiple slab gels with a single microfluidic chip. Samples are drawn onto the chip through the sipper capillary. The chip performs rapid separations of protein or DNA samples using high electric fields, followed by sensitive laser-induced fluorescence detection.

Automated Protein 1-D Electrophoresis

The LabChip 90 Protein assay is used as a direct replacement for traditional 1-D SDS/PAGE. A protein sample plate is prepared for analysis by brief heating with a denaturing buffer. The plate then is placed into the LabChip 90 system for automated analysis and reporting. Once the operator loads the plate and presses “Start”, sample analysis is a true “walk-away” process. Typical results are shown in Figure 2. The system provides three straightforward representations of each sample, 1) as an electropherogram, 2) as a Virtual Gel image, and 3) as digital results in the Results Table. The Results Table reports analytically determined values such as size and relative concentration for each protein in a sample. To calculate these values, the system runs a calibration ladder for each row of the sample plate. The sizes and relative concentrations of sample proteins are calculated by reference to calibration ladders.

LabChip 90 Protein assay performance highlights:

- Size range: 14-200 kDa
- Resolution: $\pm 10\%$ difference in molecular weight - approximately equivalent to a standard 4-20% gradient gel
- Analysis Time: 60-70 seconds per sample, compatible with 96-well plates
- Sensitivity: Equivalent to Coomassie Blue staining
- Data analysis and reporting: Automated

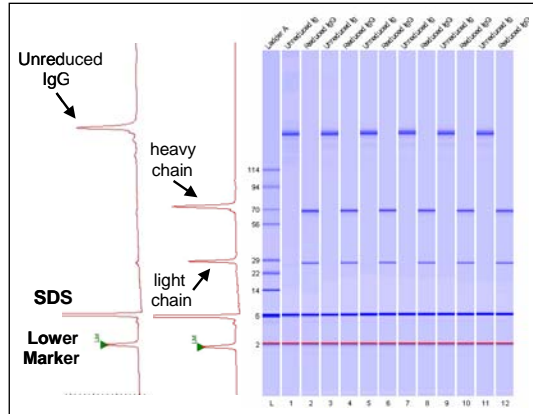


Figure 2. Typical LabChip 90 protein data showing alternating lanes on unreduced and reduced IgG antibody. The system visually represents the sample as a signal trace (left), and as a gel-like image (right). Data acquisition, analysis, and display are fully automated.

Automated DNA Fragment Electrophoresis

The LabChip 90 DNA assays are compatible with 96-well and 384-well plates of DNA fragments. The assay is optimized for use with crude PCR products and restriction digest samples. Because most samples require no purification or clean-up before analysis, the HT DNA 5000 assay can significantly streamline laboratory workflows. Similar to the HT DNA 200 Protein Assay, the DNA assay features walk-away automation, highly accurate and reproducible samples analysis, high detection sensitivity, and real-time data analysis and reporting. The sizes and concentrations of each DNA fragment are reported in the digital Results Table, which can be exported automatically for further analysis or archival storage.

LabChip 90 DNA assay performance:

- Size range: 100-5000 bp
- Resolution: $\pm 15\%$, 100-1000 bp; $\pm 20\%$ 100-5000 bp – equivalent or better than 2% agarose gel electrophoresis
- Analysis time: 30 seconds per sample - compatible with 96- and 384-well plates
- Data analysis and reporting: Automated

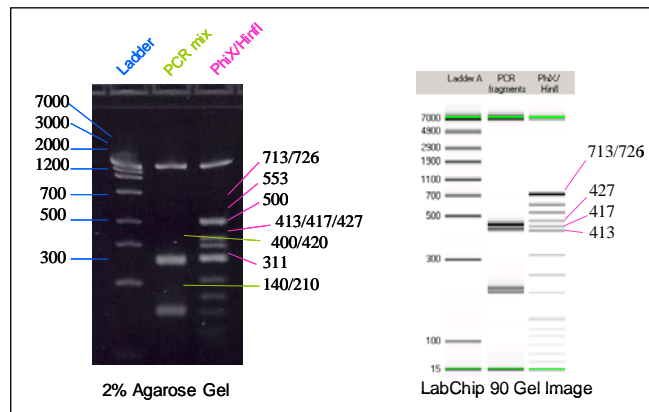


Figure 3. Relative to traditional agarose electrophoresis, the LabChip 90 DNA assays provide better sensitivity, better reproducibility, and fully automated peak identification and quantification.

Summary

The LabChip 90 System provides an automated alternative to traditional slab gel electrophoresis for protein and DNA fragment analysis. The system combines robotic automation, microfluidic LabChip technology, and advanced data analysis capabilities to meet the increasing needs of core facilities, production labs, and modern research facilities.

REFERENCE

1. Ausserer, W.A., Bousse, L., Gallagher, S.J., Kennedy, C.B., and Phan, H.L. Automated lab-on-a-chip analysis of DNA fragments. *JALA* 6 (3), 69-72 (2001).

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