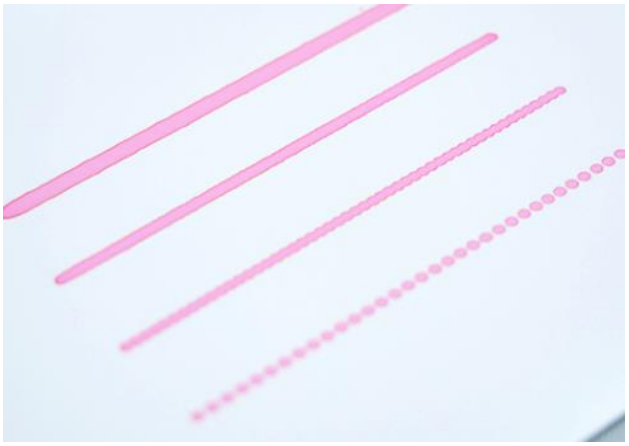
Line-based and array-based lateral flow assay development and production on the BioSpot® workstation



Introduction

Lateral flow assays (LFAs) are widely used for rapid diagnostic testing and initial screening. A one-step and low-cost analysis of an analyte in a sample solution, such as pathogens, biomarkers and chemical contaminants, makes it a powerful point-of-care device without the need of trained personnel.

Despite the benefits of such point-of-care device, conventional LFAs have one major drawback, the high consumption of reagents [1]. The miniaturization and parallelization are an urgent task to increase cost efficiency.

The BioSpot® liquid handling workstation is a superior automation platform for both developing and manufacturing LFAs. The printhead is configured with 8 nanoliter dispensers - PipeJet® for the handling of 8 different liquids in parallel. Its users benefit from the flexible printing abilities. The printing patterns can be easily tailored from line-based to array-based as well as from singleplex to multiplex LFAs.

The non-contact PipeJet® technology precisely delivers nanoliter droplets on demand and provides minimal dead volumes. Jointly, the consumption of valuable reagents can be effectively minimized without sacrificing the assay results. Owing to the piezo actuated printing mechanism, neither shear stress nor heat is generated during the printing process. It makes PipeJet® an ultimate dispenser for printing immunoassay and transferring delicate bioreagents, such as antibodies, DNA or proteins.

Material & methods

Printing line-based and array-based LFAs

The automated protocol for manufacturing both line-based and array-based LFA was developed on a BioSpot equipped with PipeJets® and the BioFluidix Control Software.

Three dispensing channels were equipped with different dispensing pipe types (125-S-C, 200-S, 500-S) to obtain the full dynamic droplet volume of a PipeJet® ranging from 2 to 70 nL. After loading the reservoirs with the liquid sample, an automated droplet volume calibration to 5 nl (channel 1), 10 nl (channel 2) and 25 nl (channel 3) was conducted via the SmartDrop System.

FIGURE 1: THE BIOSPOT® WORKSTATION, EQUIPPED WITH A MULTICHANNEL PRINTHEAD AND ADVANCED CAMERA SYSTEMS, ALLOWS FOR PRECISE AND FULLY FLEXIBLE LFA PRINTING PROCESS.

LFA Printing Process

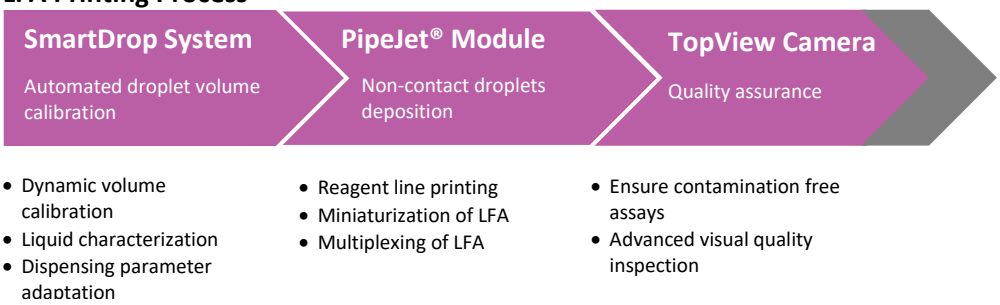


Figure 1: Schematic illustration of the LFA printing process from volume assignment, LFA printing to quality assurance

Flexible printing patterns can be easily defined in the dedicated BFX Control software by using straightforward drag and drop commands. It allows for printing homogeneous reagent lines as well as array-based reagent dots. The dimensions of the reagent lines and dots are fully adjustable to comply with the requirements of each specific application. Up to a maximum of 8 reagents can be printed simultaneously on a membrane.

The TopView Camera is implemented as a powerful in-line quality control tool. This advanced visual detection safeguards the homogeneity and the alignment of the print pattern. A contamination-free assay is ensured.

Result & Discussion

Line-based LFA

Droplets of 5, 10 and 25 nL were converted into three 70 mm long homogeneous test lines with a line width of 0.5, 1 and 2 mm, respectively. The pitch between the test lines was 5 mm. On account of the non-contact printing manner, PipeJets® left no indentation on the nitro-cellulose membrane surface.

Array-based LFA

24 identical droplets at 10 nL from a total of 8 different reagents were simultaneously arrayed on the nitrocellulose membrane forming three 2x4 multiplexing and miniaturized LFA matrices. The reagent dots were 0,6 mm in diameter and had a pitch of 2 mm.

Conclusion

BioSpot® and PipeJet®, jointly, demonstrate upmost flexibility of printing homogeneous reagent lines and miniaturized arrays. The multichannel printhead allows for multiplexing of a LFA with a maximum of 8 different reagents simultaneously.

Empowered by the advanced features of BioSpot®, BioFluidix guarantees a high throughput, precision and cost efficiency of LFA printing process, which can fulfill current and future needs of both manufacturers and developers of LFA.

Figure 2: The homogeneous reagent lines were printed with dispensing pipe ID 125-S-C (channel 1), ID 200-S (channel 2) and ID 500-S (channel 3). The reagent lines consisted of 5, 10 and 25 nanoliter droplets, resulting in 0.5, 1 and 2 mm line width, respectively.

Figure 3: The 2 x 4 matrices of multiplex LFAs were precisely arrayed with dispensing Pipe ID 200-S. Each array was composed of 8 different reagents droplets at 10 nL.

Reference

[1] Y. Wu, Y. Sun, F. Xiao, Z. Wu und R. Yu, „Sensitive inkjet printing paper-based colormetric strips for acetylcholinesterase inhibitors with indoxyl acetate substrate," 2016.

BioFluidix ordering information

Product	Order no.
BioSpot® liquid handling workstation	10025 E
PipeJet® pipe 125-S-C	PJ-20040 E
PipeJet® pipe 200-S	PJ-20000 E
PipeJet® pipe 500-S	PJ-20020 E

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