In situ protein synthesis: Cost-effective and reproducible cell-free arrays

Issue

Manuel Fuentes of the Cancer Investigation Centre (CIC), Salamanca was fortunate to collaborate with researchers at Harvard Medical School in developing Nucleic Acid Programmable Protein Arrays (NAPPA). By eliminating the need for recombinant protein production and purification, NAPPA offers a cost-effective and highly reproducible solution for biomarker and drug discovery in tumour and autoimmune pathologies. Having generated results by high-medium density immunoassays in array format, the team were using a Genetix instrument to pin-spot nucleic acids for translation to proteins *in situ*. The contact-printed arrays lacked reproducibility, displayed cross-contamination and were slow to produce.

The need for speed

Principles behind NAPPA insisted that cDNA and capture antibodies are involved in a master mix which has to be printed within a short time of window. Critical success factors meant the current instrument was no longer fit for purpose (Table 1).

Table 1: Critical success factors against results with Genetix printer

Critical success factor	Result with Genetix printer
Speed	The short timeframe in which both samples were to be deposited meant that a maximum of 20 slides could be printed in each run
Reproducibility	Samples must be printed homogenously to ensure equal protein content. The contact approach did not offer satisfactory reproducibility
Sample conservation	A minimum of 10 µg of costly sample was required to print only 20 slides
Reliability	Spots must be free of cross contamination

The Arrayjet solution

Arrayjet's non-contact inkjet technology produces spots of noticeably improved morphology compared with pin-spotting systems (Figure 1). As a result, each spot translated to a comparable quantity of protein for reliable data acquisition.

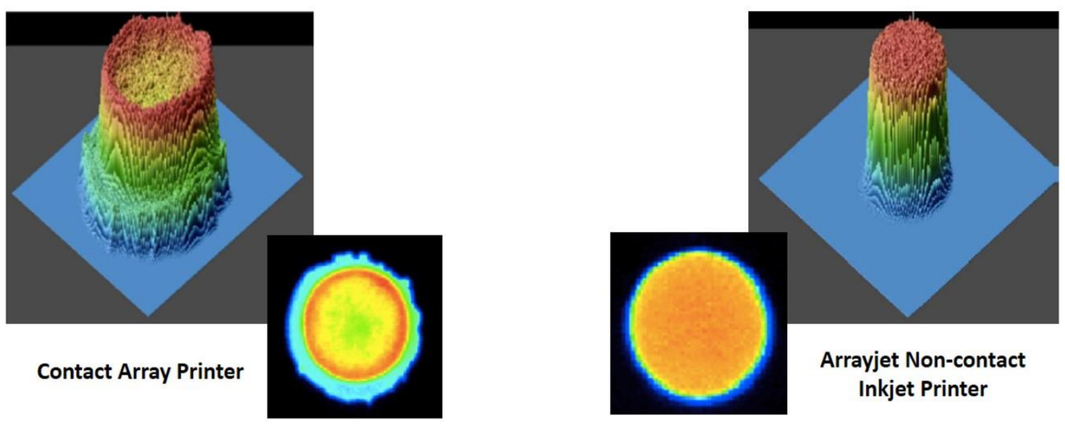

Figure 1: Homogeneity of sample distribution compared between contact pin-spotter (left) and Arrayjet printer (right)

Not only is it more reliable, Arrayjet's "on-the-fly" method is also the fastest available on the market, enabling deposition of up to 640 features per second. Sample volume requirements are vastly reduced and print runs are largely automated freeing up valuable scientist time.

Transfer to the Arrayjet platform fully satisfied all critical success factors, exceeding customer expectations (Table 2).

Table 2: Critical success factors addressed by Arrayjet technology

Critical success factors	Arrayjet resolution	Benefit
Speed	"On-the-fly" printing	High density slides printed without compromising sample
Reproducibility	Instruments and components with CV values <5%	Comparable protein quantities translated on each spot
Sample conservation	Jetspyder™ liquid handling device	1.3 µL sample aspiration prints hundreds of slides
Reliability	Integrated wash station	Print head and Jetspyder™ do not contribute to contamination

Summary

A summary of the benefits in transferring to the Arrayjet printing platform are summarised in Table 3.

Table 3: Benefits of technology transfer to Arrayjet platform

	Benefit of Arrayjet technology over contact printing
Speed	Printing time reduced fourfold leaving scientists free to conduct research
Throughput	Fivefold increase in slide production
Sample conservation	Sample volume demands reduced tenfold
Cost	Significant financial savings associated with automation, printing speed and sample conservation

Arrayjet's high-throughput printing can be adapted to suit a variety of applications, including but not limited to:

- Antigen discovery
- Host-pathogen interaction screening
- Biomarker screening
- Epitope mapping
- Antibody validation
- Small molecule library screening
- Hybridoma screening
- Gene expression profiling

Offering both an in-house bioprinting service and a range of five scalable instruments, Arrayjet remain open to any novel screening ideas that test their technology even further.

"Transfer to Arrayjet technology has had huge benefits for our cancer research and biomarker discovery. Our team can now produce 100 slides in a working day, using just 1 µg of cDNA per gene of interest. The automated process enables us to focus fully on our research knowing arrays will be printed reliably and reproducibly every time.

Manuel Fuentes, Scientific Researcher at Cancer Investigation Centre

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