Portrait™ 630 Reagent Multi-Spotter

Introducing the Portrait 630 reagent multi-spotter—the latest innovation from Labcyte Inc., the experts in acoustic droplet ejection! The Portrait 630 reagent multi-spotter is a fully automated non-contact, nozzle-free acoustic droplet ejection system optimized to deposit MALDI matrix and other reagents onto tissue sections and other samples for precision MALDI imaging mass spectrometry. Precise and flexible spot-on-spot positioning and timing enable sequential reaction chemistry and improve crystal formation, yielding higher quality, more sensitive, and more reproducible mass spectra.

Automated Acoustic Droplet Ejection – Proven Technology

Acoustic droplet ejection (ADE) uses sound energy to transfer ultra-low-volumes of liquid without the use of nozzles or tips. A piezoelectric transducer converts radio frequency power into ultrasonic energy. The sound waves are transmitted through the reagent reservoir. The pressure of the focused acoustic waves at the fluid surface creates an upwelling, and a droplet flies from the surface of the liquid (Figure 1). The Portrait 630 reagent multi-spotter creates 170 pL droplets. Larger volumes can be transferred as multiple drops. This is the same unique technology that powers the award-winning Labcyte® Echo® liquid handlers, now used worldwide in seven of the top ten pharmaceutical companies.

Totally Touchless Transfer

With ADE there is no contact between the ejection mechanism and the ejected sample or the target surface—no pipette tips, no pin tools, no nozzles. There is never any clogging, even with high concentrations of protein or crystallizing agents in volatile solvents. ADE also eliminates any danger of cross-contamination.

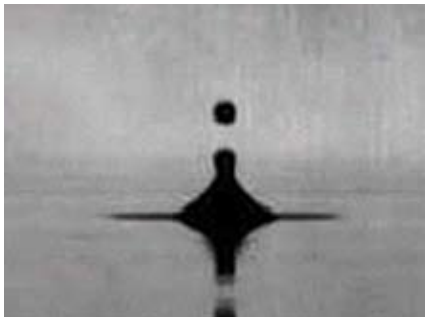

Figure 1. Stroboscopic image of acoustic droplet ejection

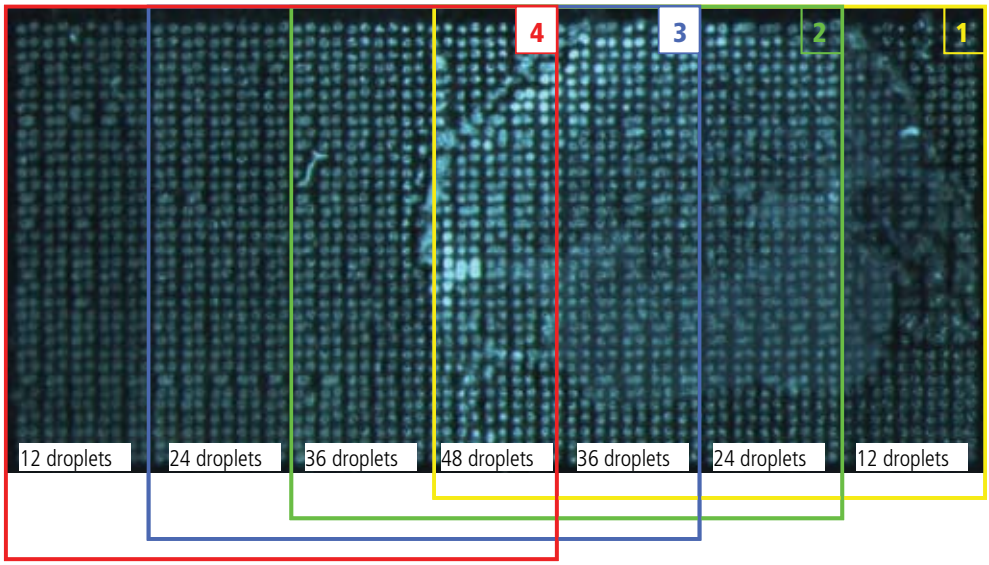

Figure 2. Example of one-step protocol optimization on a single tissue section: MALDI matrix was spotted onto a rat brain coronal section in four overlapping tiled grids (1-4). Each section contains increasing amounts of matrix.

Flexible and Fast

The Portrait 630 reagent multi-spotter gives you control over your experiments. The target holder accommodates both glass and metal targets in a variety of sizes from most of the major mass spectrometer vendors. The full-color CCD imaging system captures images of stained or unstained tissue so that you can indicate exactly where you want to apply reagents and matrix.

You specify the number of droplets per spot, the number of repeat cycles, and the timing between droplets and cycles. You can create different biochemical conditions on different areas of the sample, or perform biochemical reactions by applying reagents sequentially to the same locations. Optimize experimental conditions in a single step (Figure 2). The Portrait 630 is fast—one cycle of one droplet per spot takes less than two minutes!

Spot-on-Spot Precision

Precise spot-on-spot placement prevents biomolecules from migrating throughout a large wetted area and ensures accurate positional information from the tissue (Figure 3). Apply the same or different reagents to the same spots multiple times. By controlling the drying time between droplets, you can optimize solvent penetration, reaction chemistry, crystal formation, and spot size to yield higher quality and more-reproducible mass spectra and images.

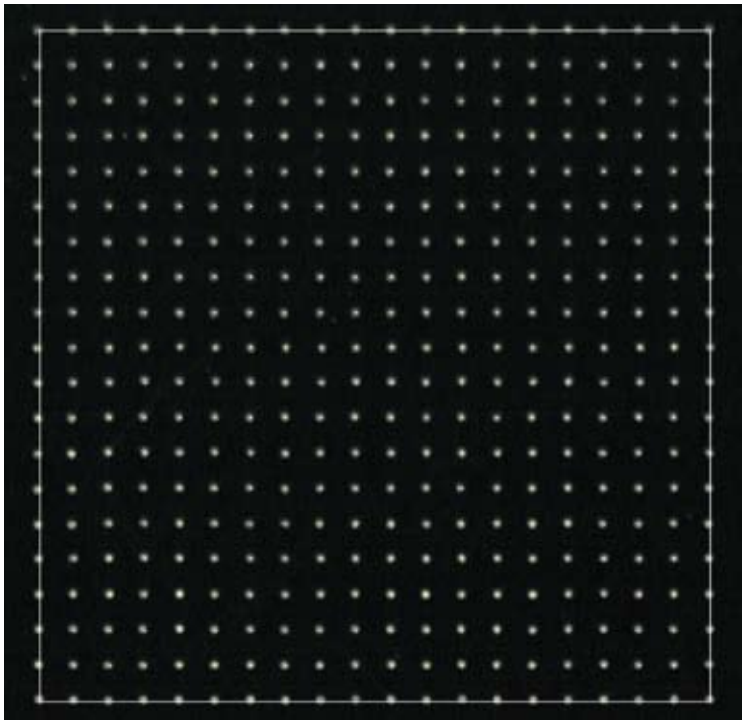

Figure 3. Positional precision of the Portrait 630 reagent multi-spotter. Scanned image of spots at 500 µm spacing on clean metal target. Average spot diameter = 141 µm, CV=4.7%. Standard deviation of X position = 8.8 µm, standard deviation of Y position = 8.7 µm. (Specification = ±40 µm.)

What is MALDI Imaging Mass Spectrometry?

MALDI imaging mass spectrometry (IMS) links the universal detection capability of mass spectrometry with the positional information of molecular histology, generating mass spectra correlated to known locations within the tissue. MALDI-IMS can reveal the distribution of hundreds of ion signals ranging in size up to 20,000 Daltons. This information can be used to determine tumor margins, drug distribution throughout a tissue or organism, and proteomic profiles under different experimental or therapeutic conditions.

Protein profiles are obtained directly from frozen tissue sections. The Portrait 630 spotter deposits MALDI matrix, enzymes and other reagents in a user-defined pattern directly onto the tissue (Figure 4). The Portrait 630 user interface allows complete flexibility for the user to control reagent deposition parameters to optimize tissue penetration, reaction conditions, crystal formation, and positional resolution for different tissue types and applications.

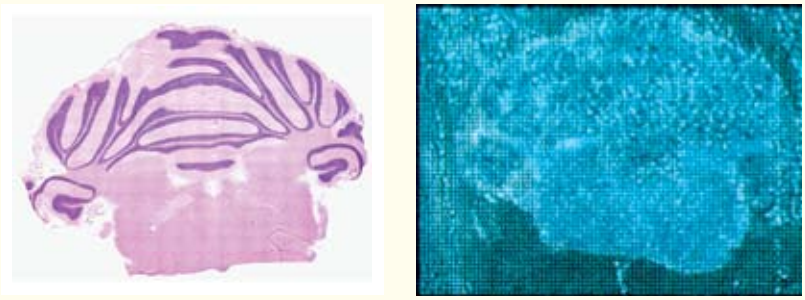

Figure 4: Left: H&E stained rat brain coronal section imaged on light microscope (10X). Right: Adjacent tissue section spotted with 25 mg/ml sinapinic acid in 1:1 acetonitrile/TFA (aqueous) using a Portrait 630 reagent multi-spotter. (Tissue sections and microscopic image courtesy of Dr. Pierre Chaurand and Dr. Richard Caprioli, Vanderbilt University.)

The coordinates of each crystalline matrix spot are transferred to the MALDI mass spectrometer, and spectra are collected for each location (Figure 5).

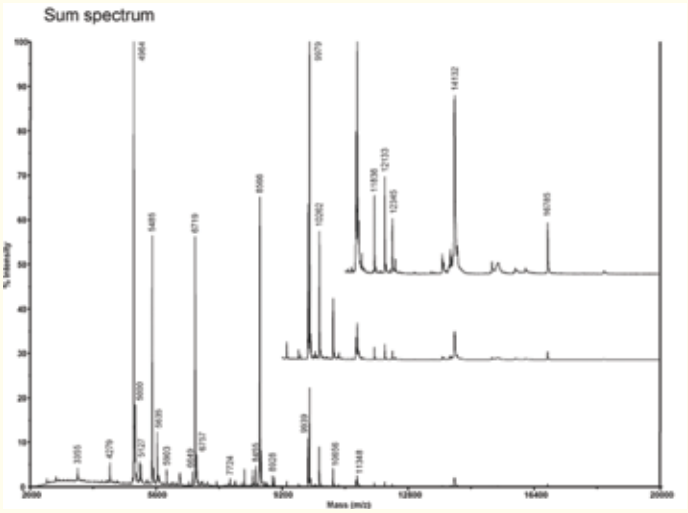

Figure 5: Sum spectrum of cumulative signal from all pixels at each m/z. Mass spectrometry was done using a Bruker Daltonics autoflex MALDI-TOF. Inset spectra are amplifications of the higher mass regions. (Spectrum courtesy of Dr. Pierre Chaurand and Dr. Richard Caprioli, Vanderbilt University.)

Molecules can be mapped directly to their locations on the tissue (Figure 6).

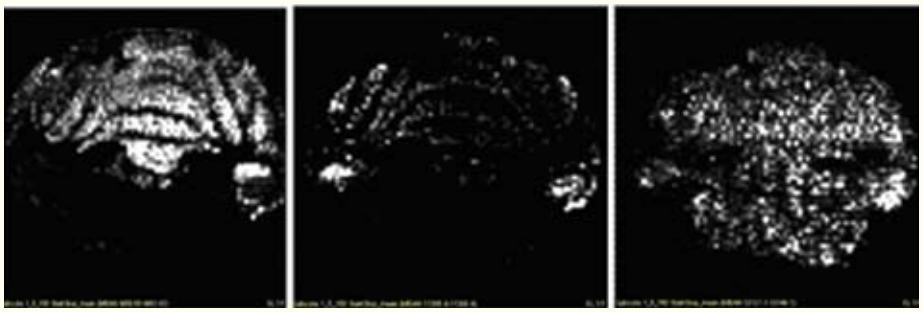

Figure 6: MALDI tissue maps constructed using BioMap image analysis software (www.maldi-msi.org). Each image represents the distribution of a single ion species in the tissue section. Left: m/z 4965 (thymosin beta-4); Middle: m/z 11306-11347 (histone H4); Right: m/z 12133 (cytochrome c). (Tissue maps courtesy of Dr. Pierre Chaurand and Dr. Richard Caprioli, Vanderbilt University.)

Further Reading

Aerni HR, Cornett DS, and Caprioli RM; Automated Acoustic Matrix Deposition for MALDI Sample Preparation, *Anal. Chem.* 78:827 (2006).

Pickett S, Chaurand P, Huang R, Stearns R, Ellson R, Caprioli RM. Acoustic Droplet Ejection Enables Precise Timing and Positioning for Deposition of Matrix to Optimize MALDI Tissue Imaging, *17th International Mass Spectrometry Conference,* Prague, Czech Republic, Aug. 27, 2006.

Specifications

Target sizes (metal or glass): 123x81mm, 75x25 mm, 44-47 mm2, 57 mm2, 55x41 mm

Droplet volume: 170 pL

Droplet deposition rate: user-adjustable up to 200 droplets/sec

Spotting speed: <2 min for 1 cycle of 1 droplet per spot (depending on sample size)

Spot-on-spot positional precision: ±40 µm

Imaging system: white light with full-color CCD camera, 80 or 20 µm pixel resolution, user-adjustable integration time

File export format: CSV and XML

Dimensions: 52 cm W x 68 cm D x 91 cm H (20" W x 24" D x 36" H)

Weight: 127 kg (280 lb)

Power: 110V/120V/240V ±10%, 50/60 Hz, 10A

Notes:

LABCYTE™

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