BioSpectrum the business of Bio & Health Sciences

Burgeoning scope of Enhanced Imaging Technologies

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Imaging technologies save lives by helping to diagnose diseases and aid the development of new therapies. From Boston to Bangalore, the demand for new and life-saving therapies has never been greater. Today, it's the focus on both small and large molecules. Tomorrow, there will be more change. In the future, advances in 3D imaging and improvements in the speed of image acquisition are expected to take off. The progress achieved in imaging technology will assist scientists in putting together a more complete picture of diseases and ultimately benefit patients worldwide. The field is also expected to shift toward increased portability of medical imaging instrumentation, with smaller ultrasound devices already on the market that can provide Colour-flow Doppler imaging powered solely by batteries

Imaging has numerous potential applications with ion mobility including: Health Sciences, Pharmaceutical – DMPK and Pre clinical toxicology, histopathology, Clinical research and pathology, Food industry, Cosmetics industry, Forensics and Chemicals industry- coatings, paints, self-organising surfaces.

India currently imports almost all major imaging equipment for diagnostics. This leads to a very high cost burden to the medical practitioners and to the patients. National Biopharma Mission (NBM) of Department of Biotechnology (DBT) supports development of core technologies and subcomponents of major diagnostic imaging equipment. According to BIRAC four

companies such as Healthcare Technology Innovation Center, Chennai; Voxelgrids Innovations Pvt. Ltd., Bangalore; Univ Labs Technologies, Delhi and Irillic Private Limited are working on this area with grants from DBT.

Increasing interest and utilisation

In the past few years, mass spectrometry imaging (MSI) has seen a rapid increase in interest and utilisation in areas such as proteomics, biomarker discovery and validation, drug distribution, and clinical research. MSI was originally developed using a matrix assisted laser desorption ionisation (MALDI) mass spectrometer, where the sample is prepared by first coating it with an ionisable matrix. Then, the sample is placed under vacuum and a rastering laser is used to ionise molecules in the sample for analysis by a Time-of-flight mass spectrometer (TOF-MS).

More recently, an ambient ionisation technique called desorption electrospray ionisation (DESI) was introduced and applied to MSI to allow for the direct analysis of surfaces at atmospheric pressure. DESI imaging uses a charged jet of solvent to deposit micro-droplets onto a surface where analytes are extracted and desorbed into the gas phase at ambient pressure and temperature. Subsequently, they are drawn into the MS inlet where they can be analysed using a TOF-MS.

DESI imaging represents a significant enhancement in the capabilities of mass spectrometers to analyse and determine spatial localisation and molecular distribution of target molecules within a variety of samples. Use of DESI imaging has the advantages of requiring minimal sample preparation to collect a wealth of molecular information. When optimised, the technique allows for either multiple analyses of a single sample (with different MS polarities if desired) or enables additional visualisation techniques (i.e. staining) to be performed on the sample after DESI imaging is complete. DESI imaging has been shown to be very effective in analyzing small molecules such as lipids or other small molecule cellular metabolites. DESI imaging provides effective and meaningful molecular spatial localization within a variety of samples with minimum sample preparation.

Waters is the sole source provider of Desorption Electrospray Ionisation (DESI) Imaging technologies. Combined with MALDI Imaging and ion mobility mass spectrometry (IMS-MS) techniques, our Full Spectrum Molecular Imaging capabilities allow the visualisation of a wider range of molecular ions and provide key insights into the underlying mechanisms of cancer, cardiovascular and neuro-degenerative diseases.

From Boston to Bangalore, the demand for new and life-saving therapies has never been greater. Today, it's the focus on both small and large molecules. Tomorrow, there will be more change. The change is constant and all need to move with the change. Looking at the current life sciences ecosystem the following will play a significant role in the next five – ten years.

Organoids: The progress made in the development of stem cell-derived organoids was a defining feature of the 2010s. Circumventing the need for animal testing in the cosmetic and pharmaceutical industries, organoids mimic human organs to provide highly accurate results during drug R&D. Supported by advances in 3D cell culture techniques to further reduce expense and the need for preclinical testing procedures, the market growth for organoids is consequently predicted to surge in the coming years. Organoids may even replace conventional research and drug discovery methods, changing the face of R&D in the pharmaceutical industry irrevocably.

Personalised medicine: Traditionally therapeutics have been recommended on a ‘one size fits for all’ basis, and drug trials are used to establish which formulations are best suited for the benefit of larger society. Today, modern genomics means it is possible to produce formulations for individuals depending on the make up of their DNA. Understanding the role DNA plays in our health and our body’s ability to fight disease makes it simpler to predict segments of the population where illness is likely to occur, make better diagnoses, and create targeted treatments dependent on individual genetic factors.

Swift testing and approvals: Biotech data is being used to speed up this process by allowing simulations of interactions between medicines and the human body, rather than having to rely on costly and time-consuming human trials for every stage of the process. Following the emergency development and approval of COVID-19 vaccinations, huge efforts have been made to speed up the process of testing and approving new drugs. Much of this is reliant on research and data originating in the field of biotechnology.

Sustainability and improved durability: In the wake of increasing environmental awareness, it is expected that in the coming decade green technologies will help accelerate the rate of change. Innovations predicted to take off in the future are varied, including regenerative and recyclable batteries. Further trends in the technological industry include finding new ways to capture and store carbon waste and increasing efficiency to reduce environmental toll.

Perhaps most significant however, are changing attitudes within the manufacturing industry, moving away from petroleum-based polymers to those of biodegradable bio-based polymers. Increasingly, in order to eliminate waste, recycling and

recirculating materials will shift design principles towards easier disassembly and manufacturing products with greater durability.

With clear understanding and foresight, together we can take one step closer to achieving our visions of the technological future. In this new decade as in all others, we are prepared to work with innovators to meet new challenges and grasp opportunities to develop the next-generation technology the world needs.

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