

# HISTORY OF ION MOBILITY SPECTROMETRY IN INDIA

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## INTRODUCTION

Over the past decades, Ion mobility spectrometry (IMS) has evolved into an inexpensive and powerful analytical technique to separate ions based on their mobility in an inert buffer gas in an electric field. The history of IMS in India is not a big picture but just like every penny counts, the contribution of Indian scientists to this field is commendable. The combination of IMS with other techniques like MS, MALDI, etc. generates value added results and opens door for number of applications in chemical warfare, forensic sciences, pharmaceuticals, proteomics, etc.

Early low-pressure ion mobility studies, along with ionization detector responses to humidity in air, during the development of several ionization detectors for GC, provided the basis of present-day radioactive ionization sources for the IMS. Due to the mass-mobility correlation observed in the early studies, IMS was thought to be "poor man's mass spectrometer."

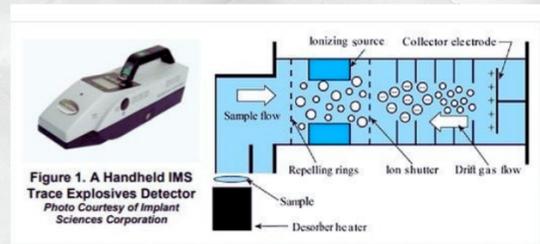
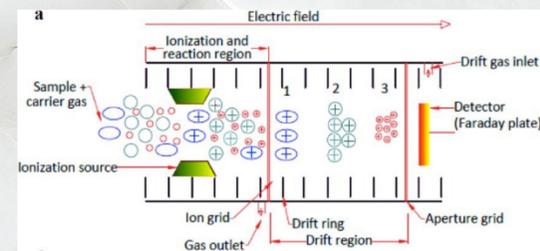


Figure 1. A Handheld IMS Trace Explosives Detector  
Photo Courtesy of Implant Sciences Corporation



## WORKING

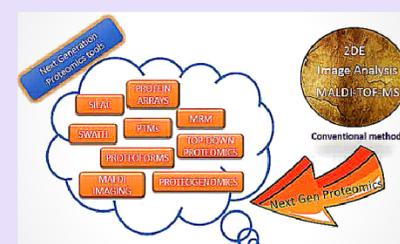
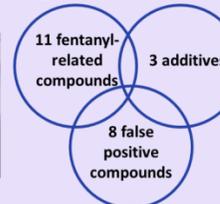
The underlying principle of ion mobility is the separation of ions on the basis of their shape, size & charge in the presence of weak electric field. Ions with higher charge experience a higher electric force resulting in a higher drift velocity. In addition, ions with larger collisional cross-sections undergo higher number of interactions. IMS-MS instrument include components which are source, drift tube, mass analyser, focusing elements, and ion detector.

## APPLICATIONS

1. Analysis of drugs by ion mobility time of flight mass spectrometry IM-TOF-MS technique is widely being used to differentiate a wide range of drug & explosive molecules using electrospray ionization(ESI) & atmospheric pressure chemical ionization(APCI) with reduced mobility in a limited period of time. Recent work is ongoing to investigate illicit narcotics specially fentanyl analogues at airports, border crossings & at postal facilities.



Testing Matrix for Fentanyl Detection

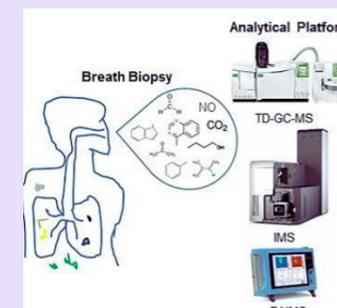


## 2. Proteomics Applications

Cancer proteomics encompasses the identification and quantitative analysis of differentially expressed proteins relative to healthy tissue counterparts at different stages of disease, using 2DE-MS based investigations and quantitative LCMS/ MS methods with oral cancer tissues, differentially expressed proteins have been identified. Currently, more than 76 research/academic institutes and 140+ research labs are involved in core proteomic research across India.

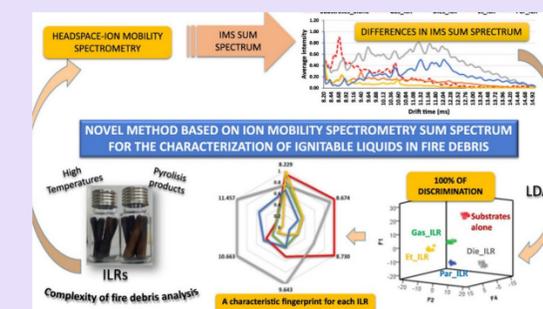
## 3. Detection of Lung Cancer by Breath Analysis

Breath volatile organic compound analysis is one promising technique for early diagnosis of lung cancer. One such technique is Ni-MCC-IMS, where the analyte sample are sent through 1000 parallel capillaries each with an inner diameter of 40  $\mu\text{m}$  and the total diameter of the separation unit is 3 mm. Once pre separated, the analytes are carried through carrier gas to IMS where they are ionized with 555  $\mu\text{Bq}$  Ni-63 radiations. The ions then are differentiated by mobility and detected by the Faraday plate.



## 4. Forensic and Security Applications

Detection of drug residues on surfaces, in saliva, urine, sweat and hair, by IMS is a widely used technique to monitor illegal drug use and trafficking. Analysis of fire debris through detection and differentiation of flammable liquids, rapid detection of biological threats by IMS are potential forensic applications of IMS.



## CONCLUSION

The combination of IMS with other techniques like MS, MALDI, etc. generates value added results and opens opportunities for number of applications in chemical warfare, forensic sciences, pharmaceuticals, proteomics, etc. Ion mobility spectrometry technique is still a young methodology in India but is being successful in conquering its unending position in the modern era of analytical sciences.

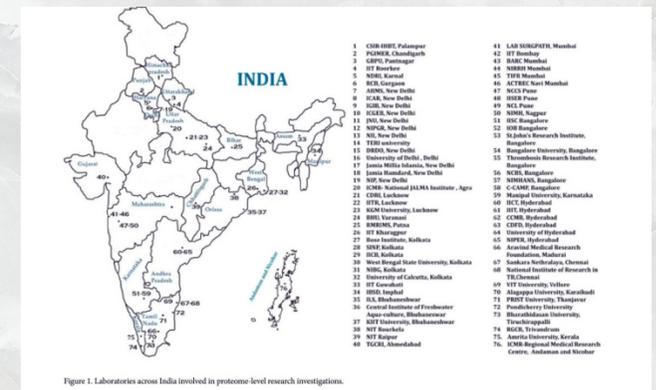


Figure 1. Laboratories across India involved in proteome-level research investigations.

## FUTURE ASPECTS

Ion mobility spectrometry technique is still a young methodology in India but is being successful in conquering its unending position in the modern era of industries where robust analytical techniques operate at high data acquisition speeds. A bright future of this technique can also be seen in the fields of petroleomics, in the discovery of drugs and enhanced e-learning practices through virtual labs.

## REFERENCES

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