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IONER
Aerosol & Volatile Analysis Technology

Aerosol Instrumentation

HIGH RESOLUTION ION MOBILITY SPECTROMETER

A NEW FIELD ANALYTICAL TECHNIQUE

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HIGH RESOLUTION ION MOBILITY SPECTROMETER

Ion Mobility Spectrometry (IMS) is an emerging technique in field analysis. IONER has developed a new concept IMS based on space classification of ions (Differential Mobility Analysis) with a high flow sheath gas that allows for higher sensitivity and resolving power that drift time IMS.

IONER High Resolution Ion Mobility Spectrometer (HRIMS) is a new instrument based on space classification of ions at ambient pressure and electrical detection of ions. This active separation allow for higher resolving power that traditional IMS. Use of a previous Photoionization stage allows for VOC detection and classification.

Measurement of ion mobility in gas phase gives a fingerprint of the chemical nature of a mixture of vapors that can be used in fields such as ion nucleation, fundamental ion research, environment, security, food inspection, diagnosis. Additionally the novel determination of ion size can be achieved.

Moreover, the IONER High Resolution Ion Mobility Spectrometer includes a multivariate analysis software that allows for specific training and the generation of custom-made libraries for signal recognition and quantification. Default library includes substance standards.

Several non-radiactive ionization methods can be used depending of the chemical family of the analyte and matrix. Photoionization (Included), Corona Discharge, Electrospray and radioactive (Ni^{63} Am^{241})

SPECIFICATIONS

Measuring principle	Ion Mobility
Mobility range	0.6 - 3 $cm^2V^{-1}s^{-1}$
Ionization	Photoionization 10.6eV (Included) Other options: • Electrospray • Corona • Radioactive (Ni^{63} Am^{241})
Sampling	Direct or with membrane
Sensitivity	PPB
Detection	Electrical current
Dynamic range	4 decades
Sample flow rate	From 0.1 to 3 $Lmin^{-1}$
Sheath flow rate	From 170 to 900 $Lmin^{-1}$
Voltage	Up to 7,5 kV
Resolving power	50 - 80
Ion polarity	Positive/negative
Measurement time lapse	2-5min
Communications	Ethernet
Powering	110-220 VAC 50-60 Hz
Max. Consumption	700W
Working temp. range	5 – 40 ºC *2
Storage temp. range	-20 – 60 ºC *2
Humidity working range	5 – 80 % *2
Weight	25Kg
Dimensions:	90x40x40 cm

*1 Standard Litres Per Minute at 20 ºC and 1 Atm.
*2 Non-condensing

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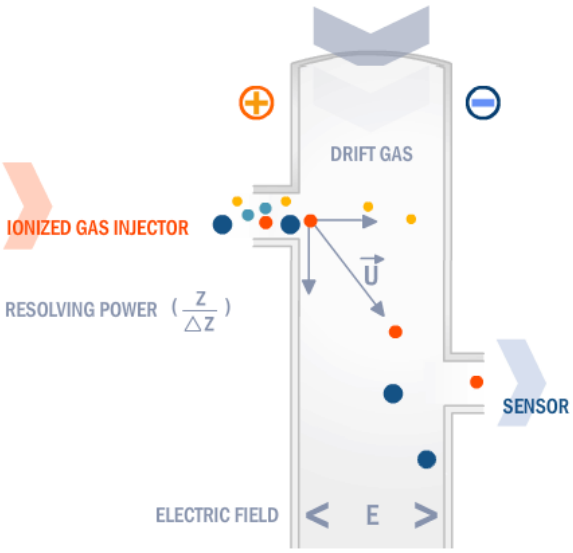
Working principle



High Flow DMA is a particular type of Ion Mobility Spectrometer in which ions are actively separated by a sheath gas at a high flow speed (tens of m/s). An electric field is superimposed in a perpendicular direction so that ions are driven by the combination of the electrical force and fluid drift. More mobile (smaller) ions are less deflected by the sheath gas than less mobile (bigger) ions. Every field-flow combination results in the classification of a current of ions all with the same mobility that flow through a slit and are detected by an electrometer. Scanning the electric field allows a complete spectrum ions with mobility between 0.6 and 3 $cm^2V^{-1}s^{-1}$.

Careful design results in limited losses and high sensitivity (ppb level).

It is capable to offer excellent repeatability and reproducibility working on continuous out-flow of mobility-classified ions. Ideal for long-time laboratory or field measuring.

The versatility of the High Resolution Ion Mobility Spectrometer enable it to work with several inter-chargeable ion sources for several chemical families. This way, the High Resolution Ion Mobility Spectrometer detects most of the chemicals that you would expect from this kind of measuring systems.

Applications

Fundamental research
Gas-aerosol nucleation studies, generation of aerosols by electrical discharges, studies of size determination.

Environment
Detection of VOCs (acetone, diethylether, formaldehyde, BTX).

Security
Detection of explosive (Nitro-glycerine, PETN, RDX, TNT, TATP, HMTD), TICs, aggressive chemical compounds.

Food Chemistry
Quality Control, anti-counterfeit.

Diagnosis
Breath analysis.

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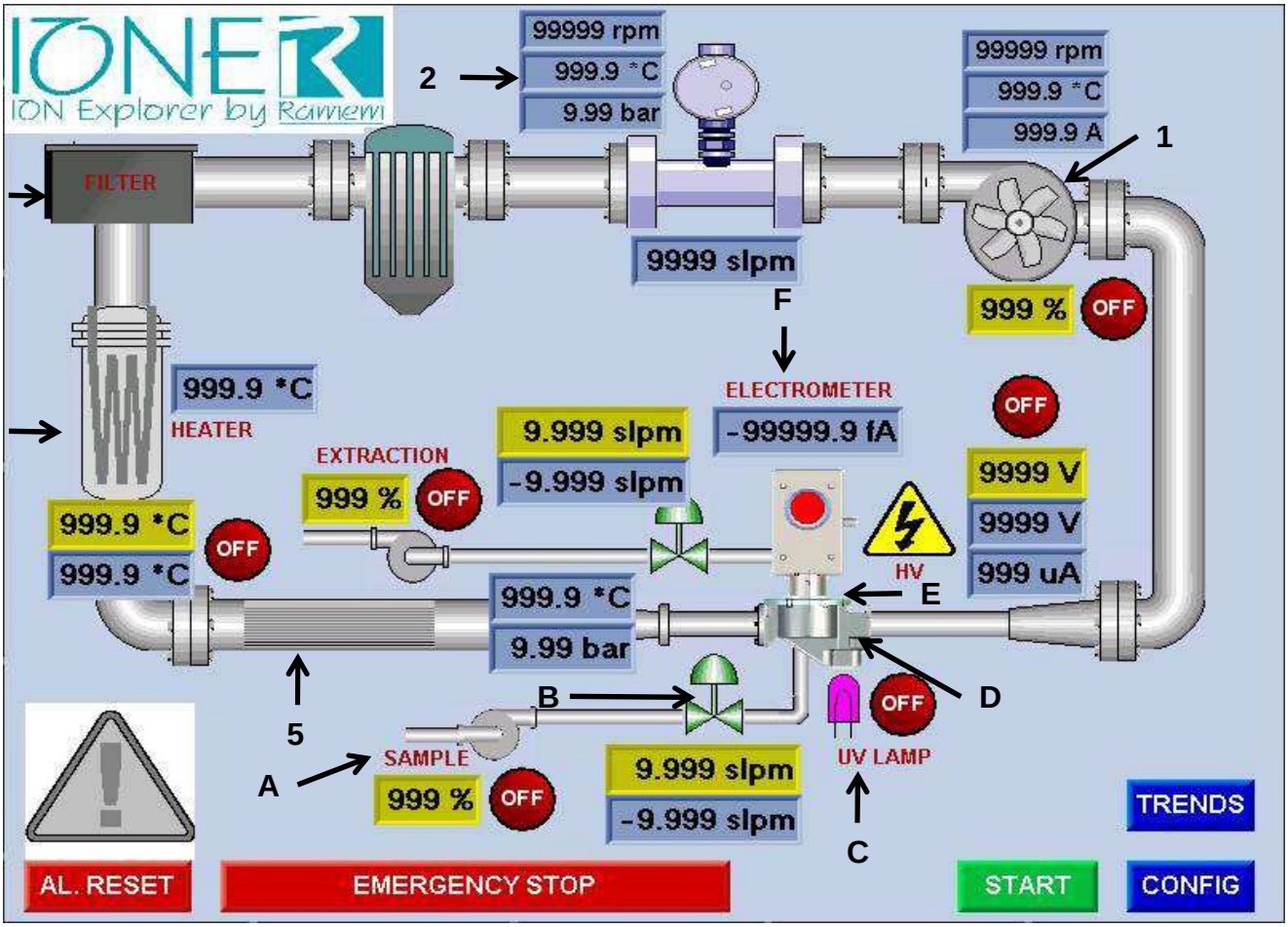
Features



IONER HRIMS system scheme

Sheath gas circuit (closed loop)

1. Sheath air flow is generated controlled by the pump.

2. Temperature, pressure and flow rate are measured.

3.Humidity and particles filters are provided to ensure cleanness of the sheath gas.

4. A heater can be used to set the air temperature as convenient.

5. The flow is laminarized to avoid turbulence in the classification region.

Ion circuit (open loop)

A. Sample is introduced at a variable flow rate.

B. Temperature control of the sample can be chosen.

C. Analytes are ionized by a UV light source.

D. Ions are injected into the classification volume and separated by the combination of electric field and sheath flow.

E. Mobility-classified ions are drawn through the outlet slit.

F. An electrometer detects the current of ions.

G. Scanning the voltage results in a full ion mobility spectrum.

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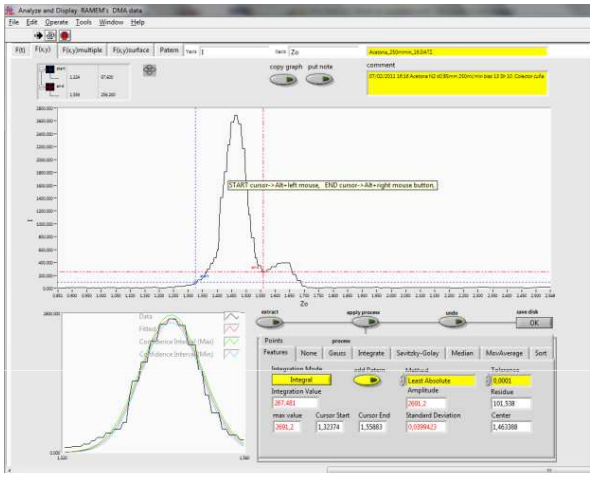
Software

IONER High Resolution Ion Mobility Spectrometer is equipped with a user-friendly software allowing for data acquisition, data analysis and substance qualitative and quantitative analysis.

Data acquisition software

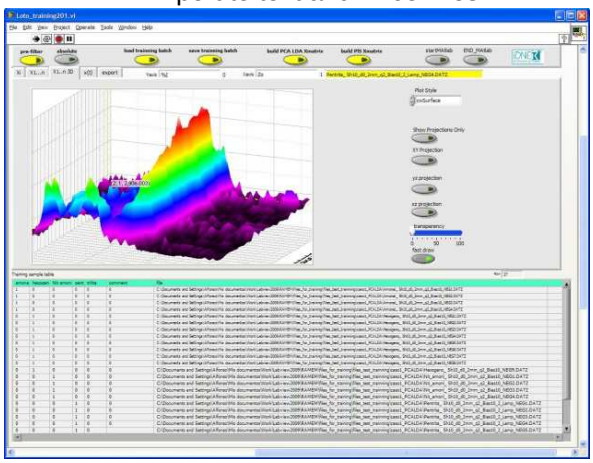
- Programming of measurements to allow unmanned operation.
- Time tracking of spectral peaks.
- Real time substance identification and quantification.



IONER High Resolution Ion Mobility Spectrometer data analysis software

Data analysis software:

- Peak identification.
- Peak integration .
- Gaussian fit and deconvolution.
- Savitzky-Golay filtering.
- Construction of time series.
- 3D plots.
- Contour plots.
- Export to text and Excel files.

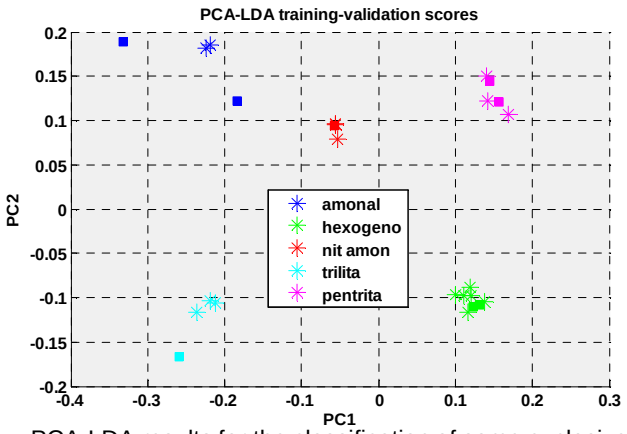


High Resolution Ion Mobility Spectrometer off-line software to build a training set

Multiavariate analysis Software

Multivariate analysis software allows for qualitative and quantitative analysis. Programmed algorithms include Principal Component Analysis-Linear Discriminant Analysis for qualitative classification and Partial Least Squares for quantitative analysis.

Default configuration includes model for lab standards. The user can construct specific trainning models for a given application.



PCA-LDA results for the classification of some explosives

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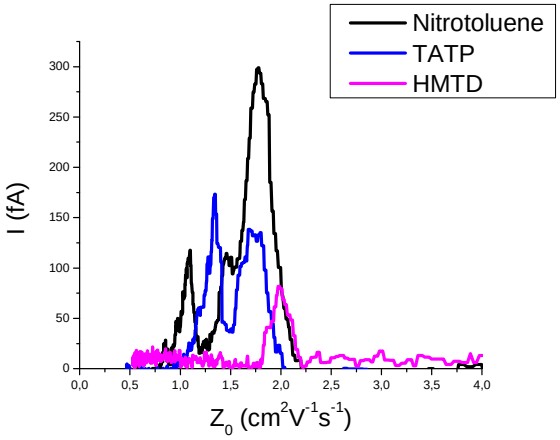
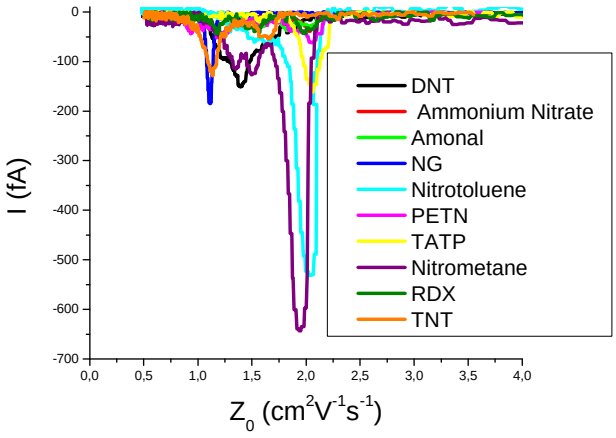
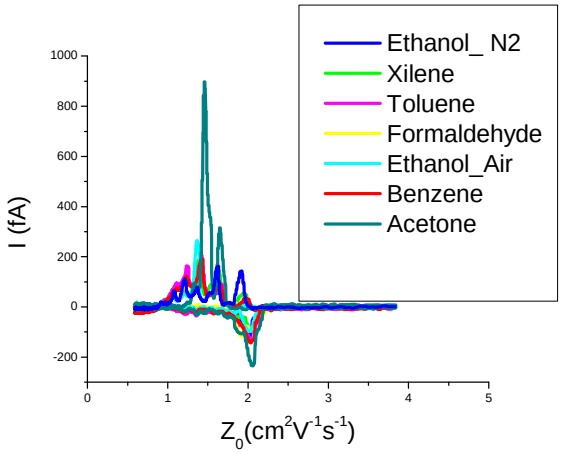
Examples

Explosives detection in positive and negative mode

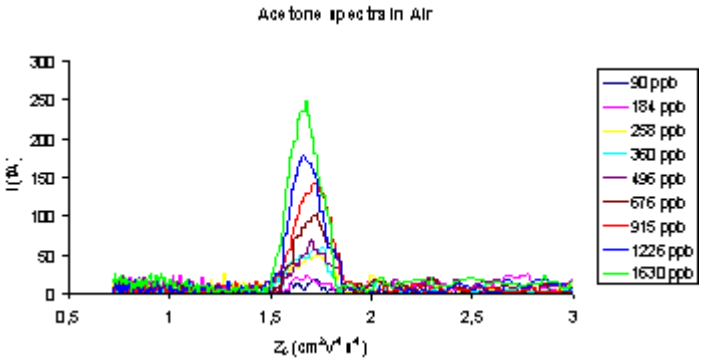




VOCs detection



Quantitative example for acetone



Publications

- Santos, J.P., Hontañón, E., Alonso, M. & Ramiro, E. 2009. Atmospheric Chemistry and Physics 9, 2419-2429
- Alonso, M., Santos, J.P., Hontañón, E. & Ramiro, E. 2009. Air and Aerosol Quality Research 9, 453-457

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