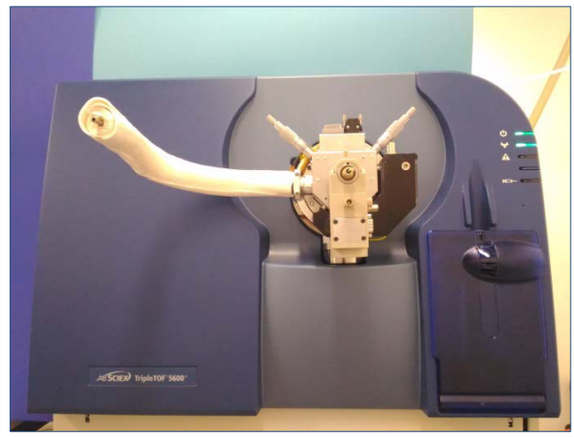
SEADM

Vapor analysis for MS



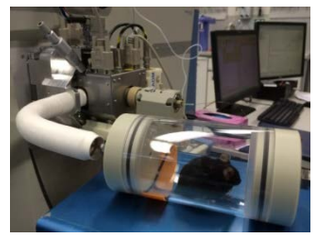
LFSESI

Low Flow Secondary ElectroSpray Ionizer

Breath analysis

Food control

Pharmacokinetics

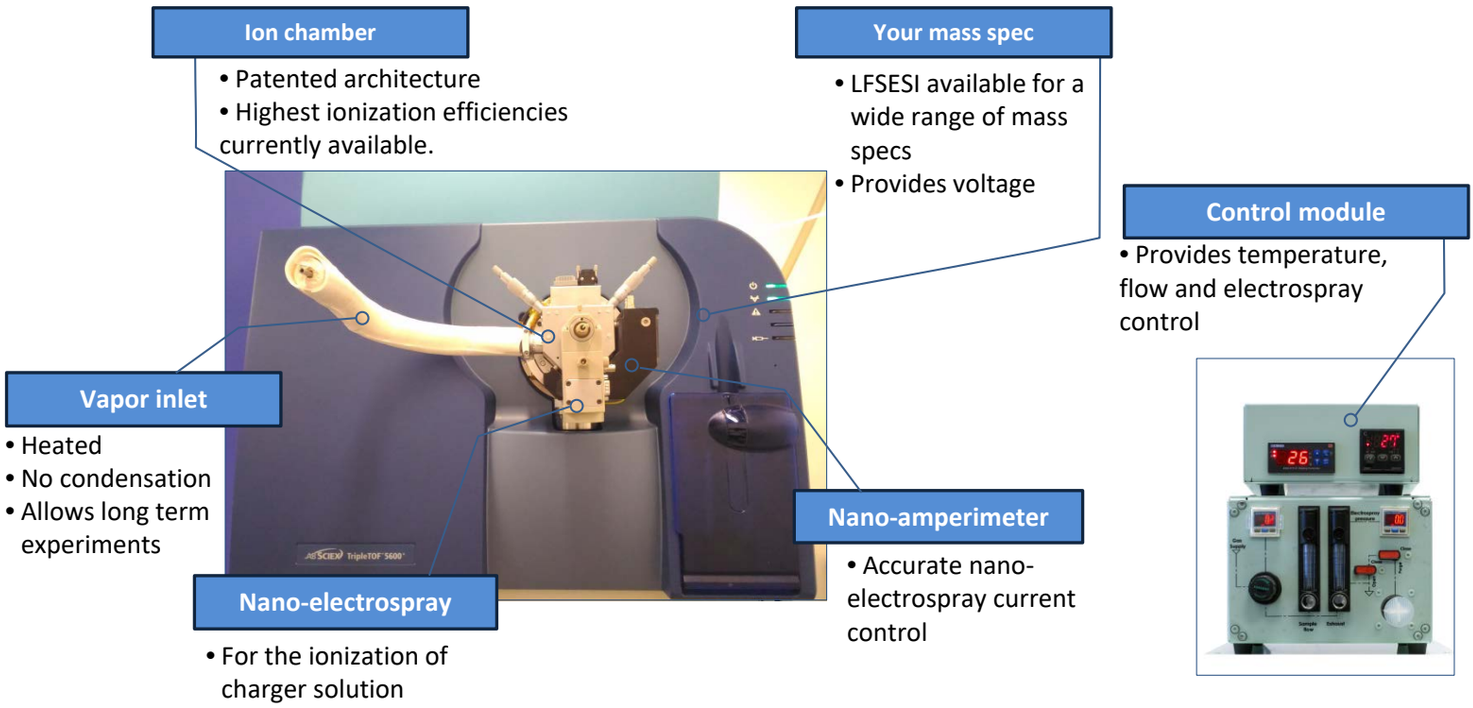


Plant physiology

LFSESI

The LFSESI is an Add-On Ionizer that turns your MS into a powerful vapor analyzer at a very small fraction of its cost

SEADM's **LFSESI** (**L**ow **F**low **S**econdary **E**lectrospray **I**onizer) is a vapor ion source used in substitution of the native MS source. It can be seemingly assembled with your current MS (weight between 5-6 kg depending on MS model) in less than **5 minutes.**

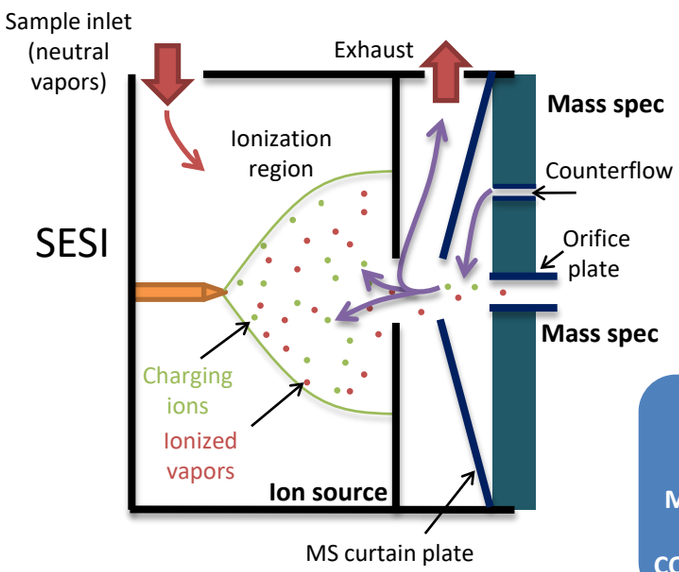


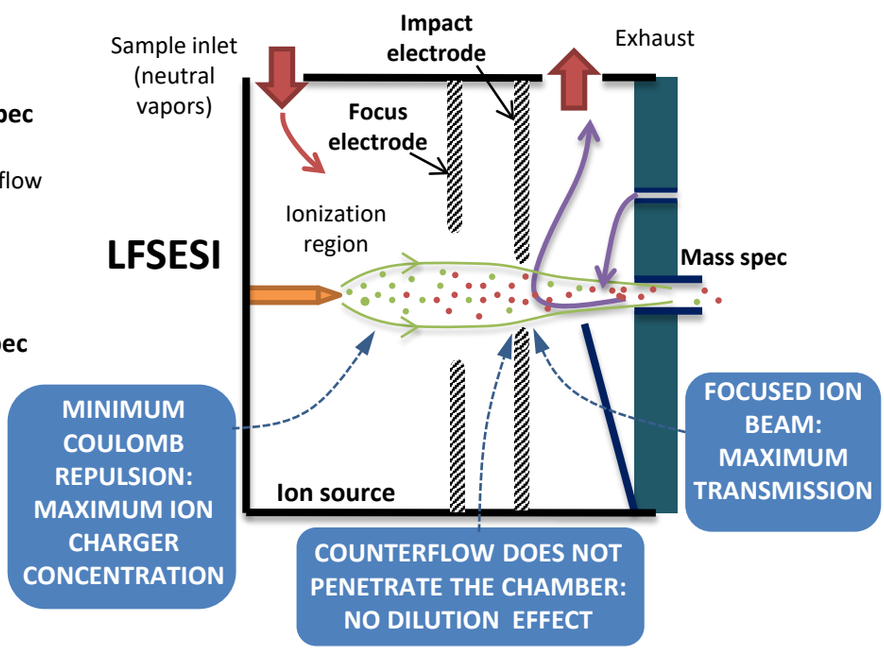
Unique ionization process: patented architecture

Secondary Electrospray Ionization is a simple, well-known way to ionize vapors for mass spectrometry:

$$Neutral\ sample\ vapours + Charger\ Ions \rightarrow Charged\ sample\ vapours$$

LFSESI boosts this principle through a unique two-electrode architecture, reducing Coulomb repulsion, avoiding dilution, maximizing transmission and yielding **<u>unmatched ionization efficiency:</u>**





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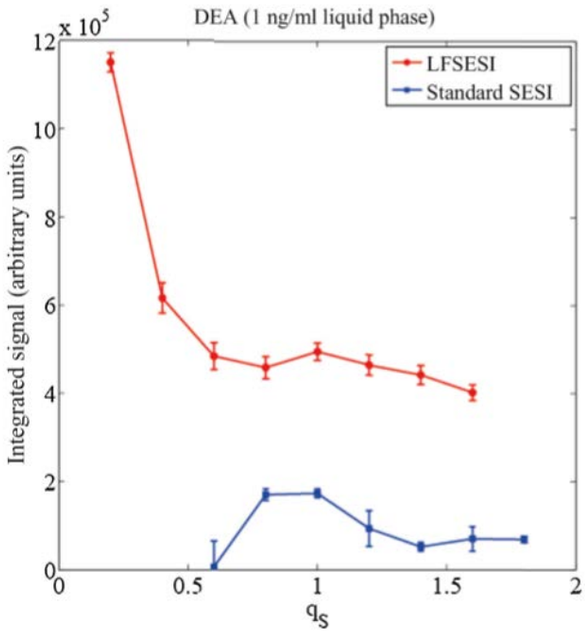
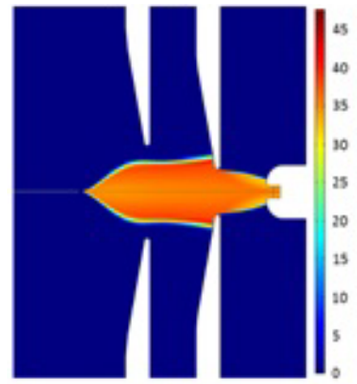
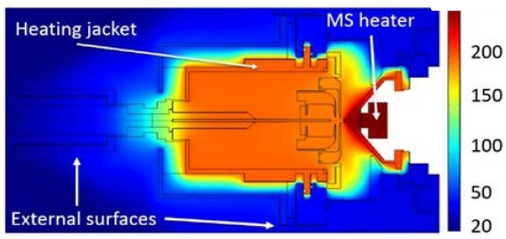
Optimized design for superb results



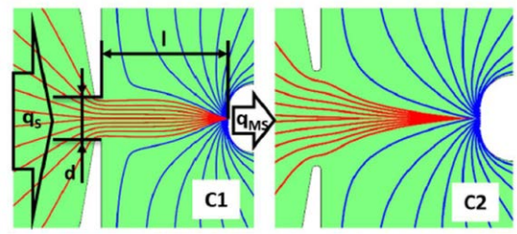
Experimental performance of LFSESI vs. SESI; DEA 23 fg/s; electrospray of H2O-HCOOH (0.1%). qs stands for sample flow rate. Ref: Sensors and Actuators, 2016



Multiphysics flow model: concentration [x10^{-16} mol/m3] of ionized TNT vapor at 1ppt, sample flow 0.05 lpm; note how the Taylor cone is effectively 'narrowed' towards the exit of the source



Careful temperature control to avoid condensation effects



Streamlined design to avoid flow stagnation

Operational advantages

- Add-on architecture to take full advantage of your MS.
- Soft ionization: LFSESI does not break your analyte molecules.
- Real time analysis
- Cost advantage: LFSESI will multiply your research capabilities at a very small fraction of the cost of your MS.
- Seamless assembly and disassembly from your MS (less than 5 minutes).
- Simple operation: working parameters and results are available through the MS user interface.
- High sensitivity (see table on the right)
- Wide range of sample flows (from 0.005 to 2 lpm).
- Carefully engineered fluid dynamics to avoid stagnant areas
- Robustness: able to continuously operate, at least, during 96 h
- Safe temperature and voltages
- Fully compliant with safety, electromagnetic and RoHS2 standards*
- Available for a wide range of Mass Spectrometers

Compound	Vapour Concentration (ppt)	Mean intensity (arbitrary units)
Melatonin [M+H]=233.13	54	**5080**
Propofol [M+H]=179.14	7	**17600**
Acetaminophen [M+H]=152.07	124	**29400**
Pentobarbital [M+H]=227.14	55	**6140**
Midazolan [M+H]=326.09	115	**322**

Response of a MS orbitrap XL to various drug vapors; mass range (Da): 50-500; electrospray: H2O-HCOOH (0.1%); mass resolution: 30000

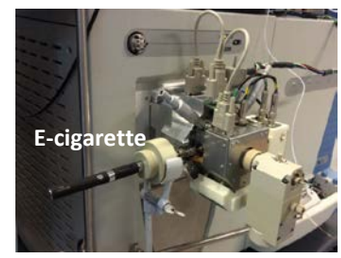
* Safety: EN 61010-1:2010 ; electromagnetic compatibility: (EN 61000-3-2:2006, EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6 and EN 61326-1:2006) and RoHS2 compliant.

Applications

o The Zenobi Group, as part of the laboratory of Organic Chemistry (LOC) of **ETH** from Zürich, **Switzerland,** is currently applying **LFSESI** for several ground-breaking researches such as:

- **Breath analysis** for rapid, non-invasive diagnosis of diseases (including alkenals and alkdienals, García-Gomez-1, 2015, and furans, García-Gomez-2, 2015).
- In vivo analysis of **yeast growth metabolism**, Tejero, 2016
- Analysis of the effect of process parameters on the **quality of wine,** Farrell, 2017
- **E-cigarette smoke safety analysis**, García-Gómez, 2016
- Characterization of oxidative stress in smokers, Gaugg, 2016
- Analysis of **vapors released from plants** ("decoding the language of the vegetable kingdom", allowing the development of a new generation of plant treatments with reduced pesticide use), Barrios-Collado, 2016

o SEADM applies **LFSESI** for the detection of explosives in cargo operations at sub-trace levels (as low as 0.01 ppq for RDX explosive). (Fernandez de la Mora, 2016).



o The University **Politecnica of Madrid,** in collaboration with SEADM, has applied the **LFSESI-MS** to detect human stress in real time and develop odor biometrics techniques from skin volatiles measurements, Rodriguez-Luján, 2013.

o The Australian Centre for Separation Science applies LFSESI for the rapid **Fingerprinting of Grape Volatile Composition** to identify grape ripening, Farrell, 2017

Customer review

Pablo Martínez-Lozano Sinues
ETH Zurich (Switzerland)

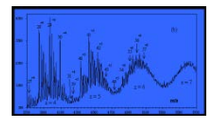
"In the first tests with the new and improved SESI measuring device, we were able to measure certain metabolic molecules in exhaled breath which scientists had not been able to detect in breath before."

See our LFSESI in action: watch our product videos

o Continuous monitoring of plant volatiles (Ref. Barrios-Collado, 2016)
https://www.youtube.com/watch?v=2WePci2jtmM

o LFSESI used for breath analysis (by ETH Zürich). Watch the source in use in its prototype status:
https://youtu.be/iEUNw6f_Pjw?t=6m34s

LFSESI



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Selected Publications

Vidal-de-Miguel G., Macía, M., Pinacho P., Blanco, J. "Low-Sample Flow Secondary Electrospray Ionization: Improving Vapor Ionization Efficiency" Analytical Chemistry, (2012), 84 (20), pp 8475–8479.

Rodriguez-Luján, I.; Bailadora G.; Sanchez-Avila, C.; Herrero, A.; Vidal de Miguel, G. "Analysis of pattern recognition and dimensionality reduction techniques for odor biometrics" Konwledge-based Systems (2013), 52, pp. 279–289.

Barrios-Collado, C.; Vidal-de-Miguel, G.; Martínez-Lozano-Sinues, P.
Numerical modeling and experimental validation of a universal secondary electrospray ionization source for mass spectrometric gas analysis in real-time, Sensors and Actuators B: Chemical, Volume 223, Pages 217-225, Feb 2016

García-Gómez, D.; Martínez-Lozano, P.; Barrios-Collado, C.; Vidal-de-Miguel, G.; Gaugg, M.; Zenobi, R.
Identification of 2-Alkenals, 4-Hydroxy-2-alkenals, and 4-Hydroxy-2,6-alkadienals in exhaled breath condensate by UHPLC-HRMS and in breath by real-time HRMS Analytical Chemistry, Volume 87, Pages 3087-3093, Feb 2015

García-Gómez D., Bregy L., Barrios-Collado C., Vidal de Miguel G., Zenobi R., Real-Time High-Resolution Tandem Mass Spectrometry Identifies Furan Derivatives in Exhaled Breath Analytical Chemistry, (2015), 87 (13), pp 6919–6924.

Barrios-Collado, C.; García-Gomez, D.; Zenobi, R.; Ibañez, A.J.; Vidal-de-Miguel, G.; Martínez-Lozano-Sinues, P.
Capturing in vivo plant m by real-time analysis of low to high molecular weight volatiles Analytical Chemistry, 2016 Feb 16;88(4):2406-12

Gaugg, T. M.; García-Gomez, D.; Barrios-Collado, C.; Vidal-de-Miguel, G.; Vidal-de-Miguel, G.; Zenobi, R.; Martínez-Lozano-Sinues, P. Expanding metabolite coverage of real-time breath analysis by coupling a universal secondary electrospray ionization source and high resolution mass spectrometry – a pilot study on tobacco smokers Journal of Breath Research, Volume 10, Issue 1, Pages 1-10, Feb 2016

García-Gómez, D.; Gaisl, T.; Barrios-Collado, C.; Vidal-de-Miguel, G.; Kohler, M.; Zenobi, R.
Real-time chemical analysis of e-cigarette aerosols by means of secondary electrospray ionization mass spectrometry Chemistry – A European Journal, Volume 22, Issue 7, Pages 2452-2457, Feb 2016

Tejero, A. et Al. In vivo mass spectrometric analysis of yeast growth metabolism, Swiss Chemical Society Fall Meeting 2016, Sep 2016

Tejero Rioseras A., Gaugg M., Martinez-Lozano Sinues, P. Secondary electrospray ionization proceeds via gas-phase chemical ionization. Royal Society of Chemistry, (Jul 2017).

LFSESI IONIZER

CONTROL MODULE

Specifications

System sensitivity	Mean intensity of 17600 for a 7 ppt sample of propofol (MS orbitrap XL; electrospray: H2O-HCOOH (0.1%); mass resolution: 30000
Flow rate	0.005 ÷ 2 lpm.
LFSESI source	Dimensions: 400x300x420 mm Weight – range (depending on MS): 5-6 kg
Control Module	Dimmensions: 410x125x255 mm Weight: 3 kg

Patents

"Ionizer for vapor analysis decoupling the ionization region from the analyzer", USPTO 8,461,523 B2, Jun. 11, 2013

"Ionizer for vapor analysis decoupling the ionization region from the analyzer", USPTO 8,217,342 B2, Jul. 10, 2012

"Method for detecting atmospheric vapors at parts per quadrillion (PPQ) concentrations", EP2538208 A1, Jun. 25, 2012. (Patent pending)

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