

## SICRIT®: Soft Ionization by Chemical Reaction in Transfer

### Introduction

Conventional ionization techniques for mass spectrometry (MS) such as atmospheric pressure chemical ionization (APCI) and electro-spray ionization (ESI) techniques have long been utilized for chromatography-mass spectrometry. They rely on generating and transferring free ions at atmospheric pressure into a vacuum ready for mass analysis.

*Mass spectrometry has never been that easy. Simple, smart and sensitive with SICRIT®!*

However, an issue with any atmospheric pressure ionization (API) source is the often long, complex and expensive sample preparation time and the unavoidable losses of analytes by charge repulsion and neutral-

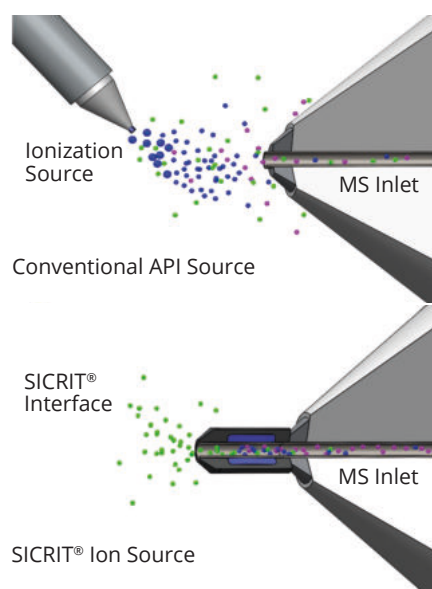


Figure 1 - Schematic illustration of the conventional API sources (top) compared to the SICRIT® ion source design (bottom). Analyte molecules (green), reagent ions (blue) and analyte ions (purple).

ization during transfer into the mass spectrometer. In this scenario, Plasmion's SICRIT® (Soft ionization by chemical reaction in transfer) technology is a revolutionary approach based on dielectric barrier discharge ionization (DBDI) to overcome these limitations.

The SICRIT® ion source is interfaced with the atmospheric pressure inlet of a MS, which is constantly drawing air through the source. Igniting a cold plasma inside the source, every substance drawn into the SICRIT® ion source is passing the plasma and gets ionized on its way to the MS. In comparison with current systems, this patented design decouples ionization from the sample delivery. Therefore, tedious sample pretreatment and lengthy adjustment/optimization of the ionization position and parameters are obsolete.

### Functioning Principle

SICRIT® extends the inlet of your MS and ionizes all molecules drawn in by your MS by means of a specially shaped cold plasma, generated by a high-frequent high-voltage (HV) supply.

*SICRIT® is the first real flow-through soft ionization technique for ambient pressure ionization (API) MS.*

The plasma is ignited within the extended inlet capillary, thus transmission and, consequently, sensitivity are greatly improved (figure 1).

The SICRIT® technology opens a broad polarity range of analytes, e.g. alkanes and organic acids can be investigated simultane-

ously, and the soft ionization mechanism minimizes fragmentation of the molecules. Even more, SICRIT® decouples ionization from the sample delivery step and converts your MS into a sensitive and selective electronic nose, giving you unlimited analytical freedom. This approach enables direct MS-based online gas-phase measurements as well as coupling with classical enrichment and separation techniques such as HPLC, GC, SPME or laser ablation (LA).

### Setup

The innovative SICRIT® ionization technology can be adapted to any API mass spectrometer by individual interfaces.



Figure 2 - SICRIT® setup (SC-20 ionization set) with MS interface, ion source and control unit (top). SICRIT® ion source, interlock and safety cap (TX2 interface) attached to a Thermo MS API inlet (bottom).

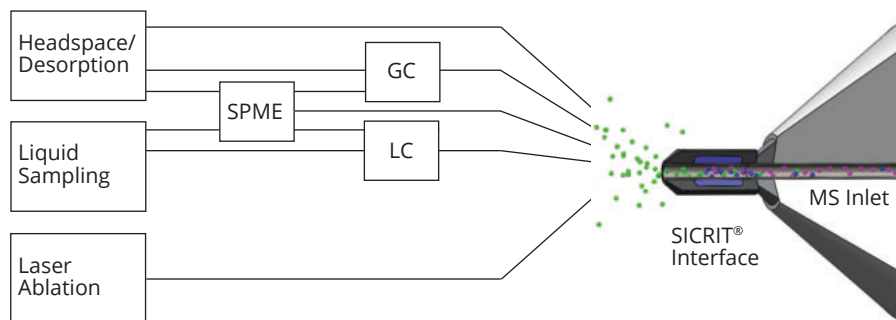


Figure 3 - Schematic illustration representing the flexibility of the SICRIT® technology towards analytes in different phases and to upgrade an existing setup or to interpose between existing devices to form new setups and analytical workflows.

The interfaces can be easily installed on your MS inlet within few minutes (figure 2). The ion source is driven by the SICRIT® SC-20 high-voltage supply unit. This control unit ensures stable plasma conditions and furthermore controls additional SICRIT® modules for combination of the SICRIT® technology with sample enrichment/separation methods.

The SICRIT® technology not only features a high-sensitive API ionization source, even more its design offers the possibility for facile and manufacturer-independent connection and combination of instruments to entirely new and powerful analytical setups (all-in-one solution; summarized in figure 3). Consequently, SICRIT® allows for global investigation of one sample in all its facets ranging

from fast headspace probing to high performance sample separation. For example, a combination of SPME with MS analysis can be realized with ease by the SICRIT® GC/SPME module, which further allows coupling of GC instruments with mass detectors (see figure 4).

#### SICRIT® Measurement Example

To illustrate the potential of the SICRIT® technology a high-resolution MS spectrum of a single coffee bean placed in front of the source at 80 °C is shown in figure 5. Without tedious sample preparation and acquired in less than a second, the analysis of the spectrum allows to identify >300 aroma compounds. For further information regarding the potential of SICRIT® for coffee aroma profiling, we refer to the related application note.

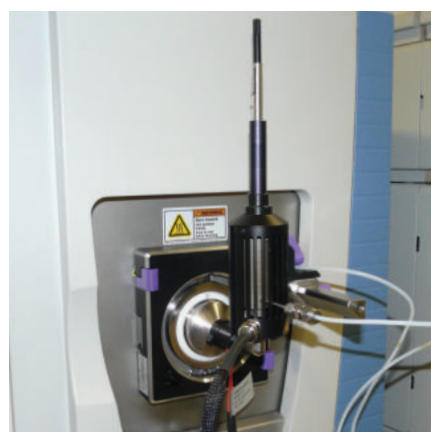


Figure 4 - SICRIT® GC/SPME module installed at a Thermo Scientific Orbitrap System.

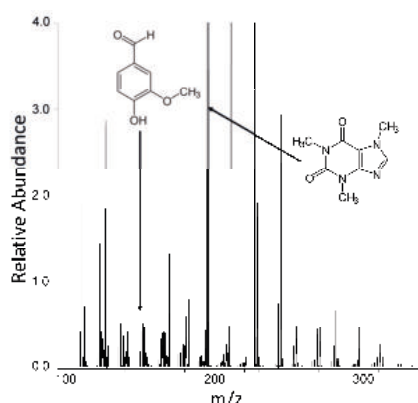


Figure 5 - Aroma profile of a single coffee bean acquired using a SICRIT® ion source attached to a Thermo LTQ Orbitrap MS; vanillin ( $m/z$  153) and caffeine ( $m/z$  195).

#### SICRIT® Advantages

- Adaptable to all available API MS systems
- High sensitivity (sub-ppt)
- Broad ionization range (positive and negative mode)
- No sample preparation and ionization tuning required
- No consumables
- Robust 24/7 operation
- Combinable with HPLC, GC, SPME and LA
- Expert manufacturer support

#### Possible Applications

- Quality and process control
- Food safety, aroma sensing
- Security and forensics
- Emission monitoring
- Clinical diagnostics
- Industry 4.0
- and many more...

#### Acknowledgements

The development of the SICRIT® technology was supported by an EXIST founding and we thank our cooperation partners from ETH Zurich and CTC Analytics AG for their contributions.

#### Related Publications

Wolf, J.-C.; Gyr, L.; Mirabelli, M.F.; Schaer, M., Siegenthaler, P. Zenobi, R. 2016, *J. Am. Soc. Mass Spectrom.*, 27, 9, 1468.  
 Mirabelli, M.F.; Wolf, J.-C.; Zenobi, R. 2016, *Anal. Chem.*, 88, 7252.  
 Mirabelli, M.F.; Wolf, J.-C.; Zenobi, R. 2017, *Analyst*, 142, 1909.

#### Further Reading

##### Product Notes

PN\_02 SICRIT® SC-20X Ionization Set  
 PN\_03 SICRIT® GC/SPME Module

##### Application Notes

AN\_01 Chemical Warfare Agents – Direct SICRIT®-MS Analysis  
 AN\_02 Coffee Aroma Profiling – Direct SICRIT®-HR-MS  
 AN\_03 SICRIT®-MS: New Workflows in MS-based Analysis