

MS Tips No.35 Cold-Spray TOFMS: Effect of Retractable Flow Redirector

In general LC-MS, ESI is known to be effective for analysis of ionic or polar compounds as the softest ionization method. However, it is extremely difficult for ESI to identify the structure of labile organic compounds in solution. Cold-spray ionization¹⁾ is a new technique recently developed to solve this problem.

Cold-spray ionization, reported by Dr. Kentaro Yamaguchi, Tokushima Bunri University, is designed to ionize samples at low temperature by cooling nitrogen gas spray. Ions generated by this technique are likely to be ionized while maintaining the associative structure reflecting the inherent properties of molecules. Studying these ions will enable general structural analysis including molecular functions and peripheral environment.

In 2003 JEOL announced the JMS-T100CS AccuTOF CS, incorporating a new ion source designed to support cold-spray ionization. The new ion source features a retractable flow redirector designed to switch the direction of spray between vertical and coaxial. We analyzed proline in an AccuTOF CS, studying the effect of the retractable flow redirector.

AccuTOF CS: System Overview

- Features of AccuTOF -

The AccuTOF CS, keeping the same levels of spectral sensitivity, mass accuracy, and wide dynamic range as the AccuTOF, has an additional advantage of easy maintenance.

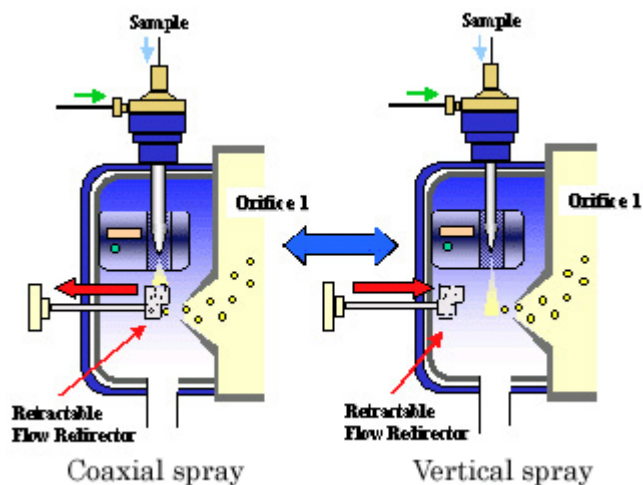
The isolation valve on top of the MS system allows the ion source/injector and the analyzer/detector to independently control evacuation.

This design substantially enhanced the speed and minimized the labor required for daily maintenance.



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- Retractable Flow Redirector -



Vertical gas flows from the sprayer are effective in minimizing contamination buildup in the MS system. For some samples, however, ionization efficiency is often inferior to coaxial gas flows.

Thus, the ion source integrates a retractable flow director controlling gas flows from the sprayer in vertical and coaxial directions.

Analysis of proline

- Objective -

We analyzed proline, a cyclic amino acid, using cold-spray ionization. We used the retractable flow redirector to acquire data with vertical and coaxial gas flows, identified cluster ions from the mass spectra, and studied the effect of the retractable flow redirector.

The temperature at the tip of the sprayer during the experiment was 0 to 10 degrees.

Acquisition Conditions (L-proline)

Sample introduction	Infusion with syringe pump
Flow rate	1.0 ml/hr
Ionization	Cold-spray
Coolant	Liquid nitrogen
Desolvating temperature control	OFF
Orifice 1 temperature control	OFF
Nebulizing gas	N ₂ (0.75 L/min)
Dry gas	OFF

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Needle voltage	0 V and 2000 V
Ring lens voltage	20 V
Orifice 1 voltage	100 V
Orifice 2 voltage	5 V
Ion guide voltage	2500 V
Detector voltage	2800 V
Mass range	m/z 200 to 5000
Experiment time:	3 min
Recording interval	10 sec

- Results -

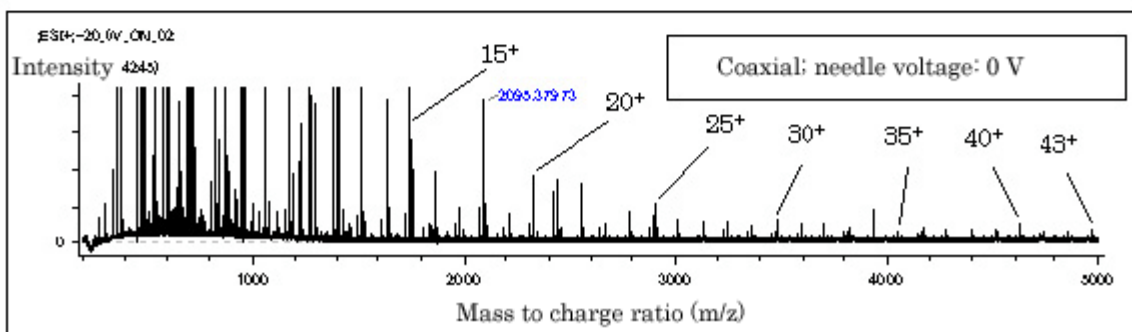
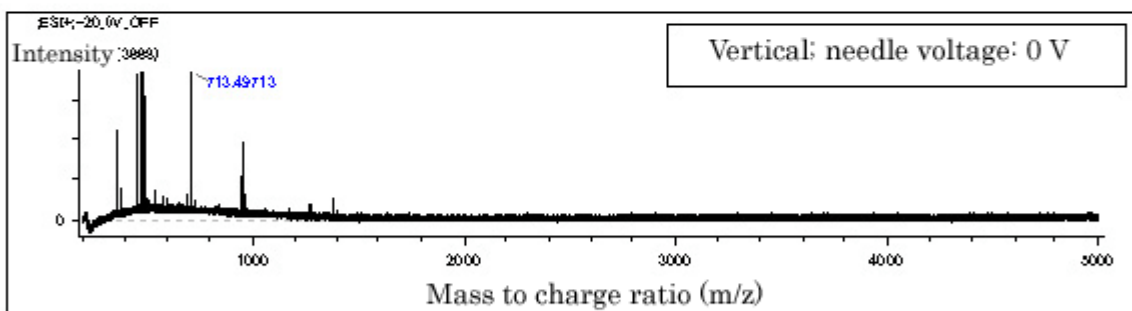
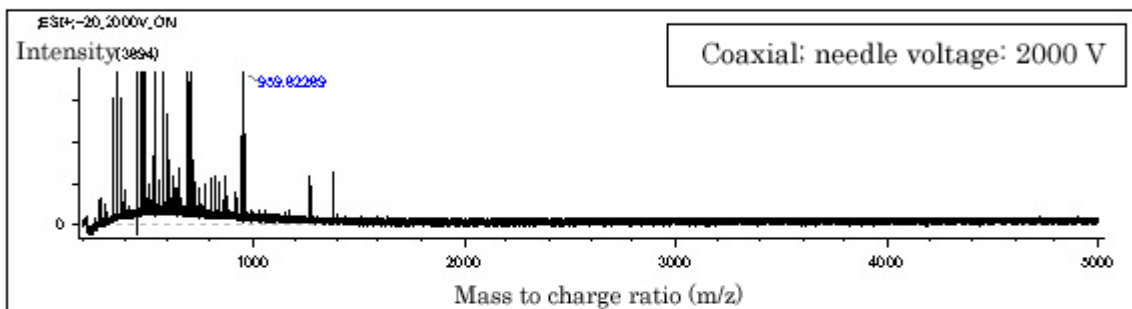
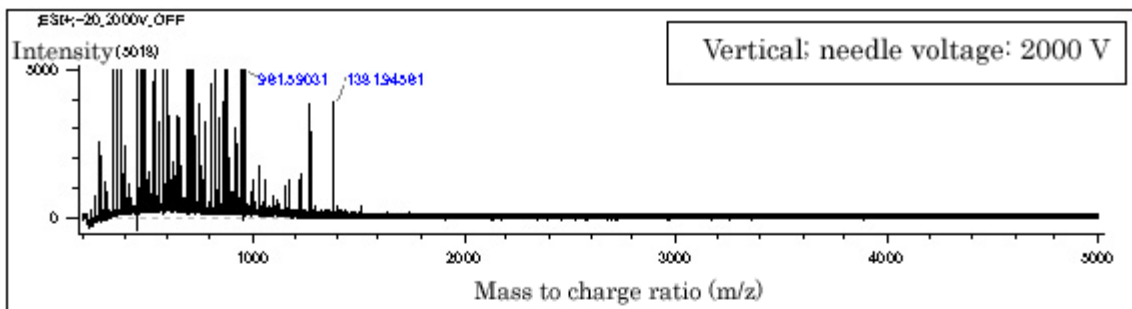
With the vertical gas flow, no cluster ions were detected when the needle voltage was set to 2000 V and 0 V.

On the other hand, with the coaxial gas flow, cluster ions were detected in a mass range of up to 5000 Da when the needle voltage was 0 V, although no cluster ions were detected when the needle voltage was 2000 V. The system detected single charged ions of up to 43 in the proline multimer.

The results demonstrate that cold-spray ionization is extremely effective in identifying biomolecular clusters composed of a relatively weak hydrogen bond such as proline. The retractable flow redirector was also effective in such analysis.

When using cold-spray ionization on biomolecules, the direction of the gas flow should be selected according to the sample analyzed.

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[Reference]

- 1) K.Yamaguchi: Cold-spray ionization mass spectrometry: principle and applications, Journal of mass spectrometry, 2003, 38, 473-490