FUSION PTR-TOF 10k – Next generation PTR-TOF instrument

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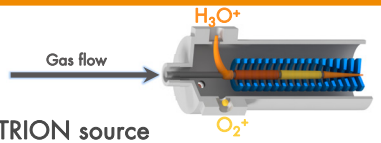
https://www.ionicon.com/products/details/fusion-ptr-tof-10k

Introduction

The possibility of on-line measurement and detection of compounds with high sensitivity has been highlighted as one of the main advantages of **P**roton-**T**ransfer-**R**eaction – **M**ass **S**pectrometry (**PTR-MS**) [1] since its introduction in the 1990s.
The quest for the highest sensitivity has recently led to a multitude of reaction chamber designs, all of which have in common that they employ RF fields to guide and focus the ions. However, this comes with a major drawback, namely that the well-defined ion chemistry in PTR-MS, which is one of the most important features of this technology, is sacrificed [1].
Here we present the FUSION PTR-TOF 10k, which is part of IONICON's Next-Gen PTR-TOF instrument series and combines the novel TRION source and FUSION drift cell. The novel TRION source plus the FUSION reaction chamber and a high resolution TOF analyzer are the new benchmark for nearly instant reagent ion switching, ppqv limit of detection and reliable E/N-values.

FUSION PTR-TOF 10k



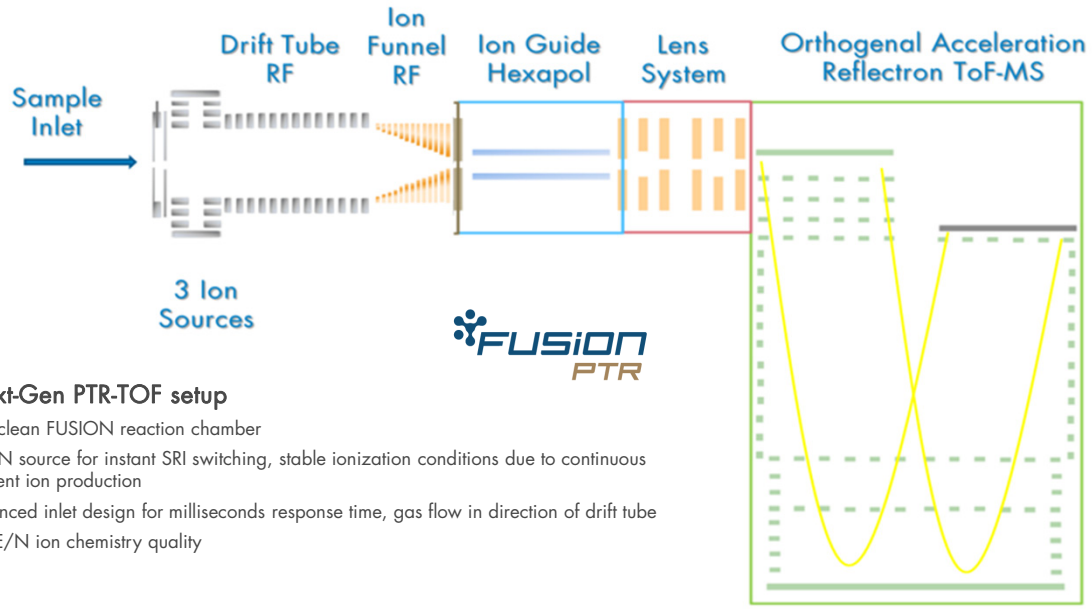
TRION source

- 3 reagent ion sources, positioned around a virtually contact free sample inlet
- gas flow in direction of drift tube
- continuously producing up to 3 reagent ions at the same time, e.g. H_3O^+ [1], NO^+ [2], NH_4^+ [3], O_2^+ [2]
- switching times up to 100-200ms

FUSION reaction chamber

- mounted within an enveloping recipient
- directly injected sample air flows through a series of gas-tight ring electrodes
- pumped through the gaps between the adjacent ion funnel electrodes
- leaks are virtually impossible due to enveloping recipient

Overview



A Next-Gen PTR-TOF setup

- ultra-clean FUSION reaction chamber
- TRION source for instant SRI switching, stable ionization conditions due to continuous reagent ion production
- advanced inlet design for milliseconds response time, gas flow in direction of drift tube
- TRU-E/N ion chemistry quality

Key Advantages

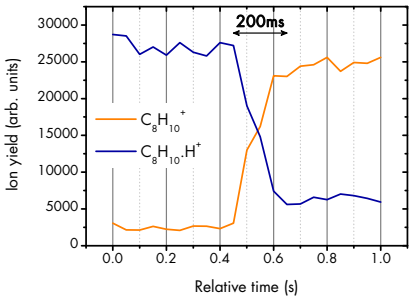
A unique combination of:

- high sensitivities up to 30,000 cps/ppbv
- LoDs down to <100 ppqv
- selective reagent ion (SRI) switching in about 200ms, high stability of different reagent ion sources
- FUSION PTR technology is best combined with ioniTOF 10k with a mass resolution of typically 10,000 – 15,000 m/Δm (FWHM)
- patented TRU-E/N ion chemistry quality

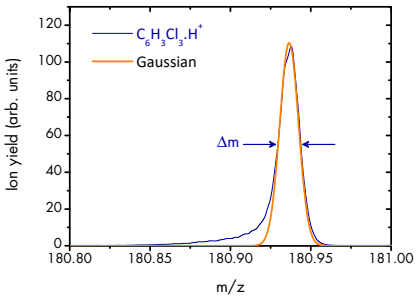
Results

The performance of the novel FUSION PTR-TOF 10k instrument was evaluated with a gas feed containing1-2 ppbv of various compounds.

Fast selective reagent ion (SRI) switching
With the new setup, reagent ions can be switched with times as short as 200ms, as shown below for switching the reagent ion H_3O^+ to O_2^+.



Mass resolution and high sensitivities
At the same time, high mass resolution and high sensitivities are achieved time, as shown below for $C_6H_3Cl_3.H^+$
Mass resolution: >12,000 (FWHM)
Sensitivity: > 10,000 cps/ppbv



TRU-E/N
We were able to reproduce the fragmentation pattern of pinonic acid upon PTR ionization. The branching ratios are very sensitive to the applied E/N. Utilizing our patented TRU-E/N method (US10074531, EP3309817), we were able to reproduce intensity ratios for all relevant pinonic acid product ions corresponding to E/N values from regular operating conditions, i.e. without the use of RF voltages, of 120 Td down to 60 Td using a FUSION PTR-TOF.
For example, using the relative ion yield of the thirteen different fragments formed from pinonic acid during ionization by PTR, we obtain a Pearson correlation coefficient of 0.97 in the case of 60 Td.

References
[1] A.M. Ellis, C.A. Mayhew, In: Proton Transfer Reaction Mass Spectrometry: Principles and Applications, Chichester, UK: John Wiley & Sons, Ltd (2014). ISBN: 978-1-405-17668-2
[2] A. Jordan et al., An online ultra-high sensitivity Proton-transfer-reaction mass-spectrometer combined with switchable reagent ion capability (PTR + SRI – MS). Int. J. Mass Spectrom. 286 (2009) 32-38. DOI: 10.1016/j.ijms.2009.06.006
[3] M. Müller et al., A novel method for producing NH_4^+ reagent ions in the hollow cathode glow discharge ion source of PTR-MS instruments. Int. J. Mass Spectrom. 447 (2020) 116254. DOI: 10.1016/j.ijms.2019.116254