ENHANCEMENT OF PRECURSOR ION SCANNING ON A Q-TOF INSTRUMENT USING A TRAVELLING WAVE ION MOBILITY SEPARATOR

TOF MS ES+

990.58

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INTRODUCTION

Precursor ion experiments on scanning tandem MS instruments are of relatively low efficiency due to the requirement to scan the first mass analysis over a selected mass range. With tandem quadrupole instruments, the second quadrupole operates at the fixed m/e of the product ion so transmission efficiency is inherently high. However, with Q-ToF type instruments the 2D TOF analyzer which introduces further losses in ion transmission, in part due to low duty cycle, especially of low m/z ions. The overall duty cycle can be typically less than 0.1%.

The Q-ToF duty cycle may be significantly increased by transporting ions to the orthogonal acceleration region using a travelling wave (TWave) ion guide. The TWave ion guide converts the conventional ion beams into discrete packets and by subsequent synchronization of the arrival of ions of a specific m/z value from each packet with the TWave acceleration step, signal enhancement occurs over a m/z window centered on the ion of interest. Thus we report a method for further improving the duty cycle of a Q-ToF instrument by replacing the scanning quadrupole with a TWave Mobility Separator.

EXPERIMENTAL

TWave Ion Mobility Separator

The TWave ion mobility separator is a stacked ring electrode device with opposite phases of RF applied to adjacent electrodes to provide radial ion confinement. A DC voltage pulse pattern is applied to the ring electrodes so as to provide travelling wave pulses which project ions through the gas-filled device. Through appropriate choice of the wave parameters mobility separations can be achieved on low mass ions over the ‘waste’ mass range lower than the highest ions detected. Experiments were performed on a modified Q-ToF Premier instrument, shown in Figure 1. Modification includes a separate pump chamber which houses the TWave ion cell, followed by a further pumped chamber containing a hexapole ion guide and a 5T crossed-field collision cell to perform mobility separations. Ions are stored in the source TWave ion guide and gated out for 100 µs every 1.8 s.

RESULTS

Figure 2 shows the mass spectra obtained with the conventional tandem quadropole precursor ion scanning for decreasing concentrations of vitamin D3 in a protein free buffer (0.1% formic acid). As compared to the results of Figure 2, the TWave ion guide allowed the separation of the mobility ions and the TWave ion cell was tuned to selectively suppress the 381.34 m/z ion. The TWave ion mobility and associated mass spectra of Figure 3 illustrate the technique of enhanced precursor ion scanning on a modified Q-ToF Premier MS. Row 1 shows the low ion energy collision induced dissociation and the summed mass spectra for 300 µg/g of vitamin D3.

CONCLUSIONS

• This study has demonstrated the feasibility of using a mobility-based separation of precursors to enhance duty cycle when compared with a scanning quadrupole.

• Further increases in performance have been demonstrated by using ECD detection.

• This technique has been shown to enhance the sensitivity of precursor ion detection by at least a factor of 100 compared to the tandem quadrupole instrument.

Figure 6 shows the mass spectra obtained with the modified Q-ToF Premier MS and associated mass spectra obtained under low and high energy conditions for 100 µg/g of beta-casein digested with the modified Q-ToF Premier MS.