Coincidence time-of-flight mass spectrometry of electron impact on anthracene using a field programmable gate array

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Synopsis A new data acquisition system for electron-impact time-of-flight mass spectrometry has been set up, in which a field programmable gate array is used for the timing and the recording of mass spectra on an event by event basis. Fragmentation studies of anthracene have shown clear evidence for double ionization above 21 eV electron impact, which provides the motivation to look for coincident fragments. The first results for coincidence mass spectrometry of anthracene will be presented at the conference.

Mass spectra for positive ions produced by low-energy electron impact on anthracene and phenanthrene [1, 2] have produced clear evidence for double ionization above 21 eV. Groups of fragments with 6 and 7 carbon atoms clearly show the presence of doubly-charged fragments at half-integer masses. The smaller fragments with 1 to 4 carbon atoms all show broadened peaks, and these fragments may be partly or mostly due to energetic charge-separation fragmentations of doubly-charged anthracene and phenanthrene. For this reason it is of interest to perform coincident time-of-flight mass spectrometry using electron impact. In ion-molecule collisions this technique has been applied regularly, including to doubly-ionized anthracene molecules produced by double electron transfer to 5 keV protons [3].

In our earlier work [1, 2] we measured mass spectra for positive ions using a refectron time-of-fight mass spectrometer, where electron impact energy was varied from 0 to 100 eV in steps of 0.5 eV. Ion yield curves and appearance energies of most of the fragment ions of anthracene and phenanthrene were determined. Two key components in our time-of-flight mass spectrometry experiment were a FastComtec 7886S multichannel scaler and a digital delay generator. The multichannel scaler was used for recording mass spectra, and the delay generator was used to synchronise the pulsing of the electron gun, the ion extraction voltage, and the start of the multichannel scaler. Data acquisition was automated with a PC using LabView control.

We have implemented a new data acquisition system in which a field programmable gate array (FPGA, National Instruments cRIO9075) is used for the timing of the pulsing of the electron gun and the ion extraction voltage, and for the recording of mass spectra on an event by event basis. We have developed LabView code for both the communication between the FPGA and a PC, running on the FPGA chassis, and the control of the experiment and the data acquisition, running on the PC.

Initial tests with the FPGA have shown that we can accurately measure mass spectra, and first results of the coincidence tests will be presented at the conference.

References

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