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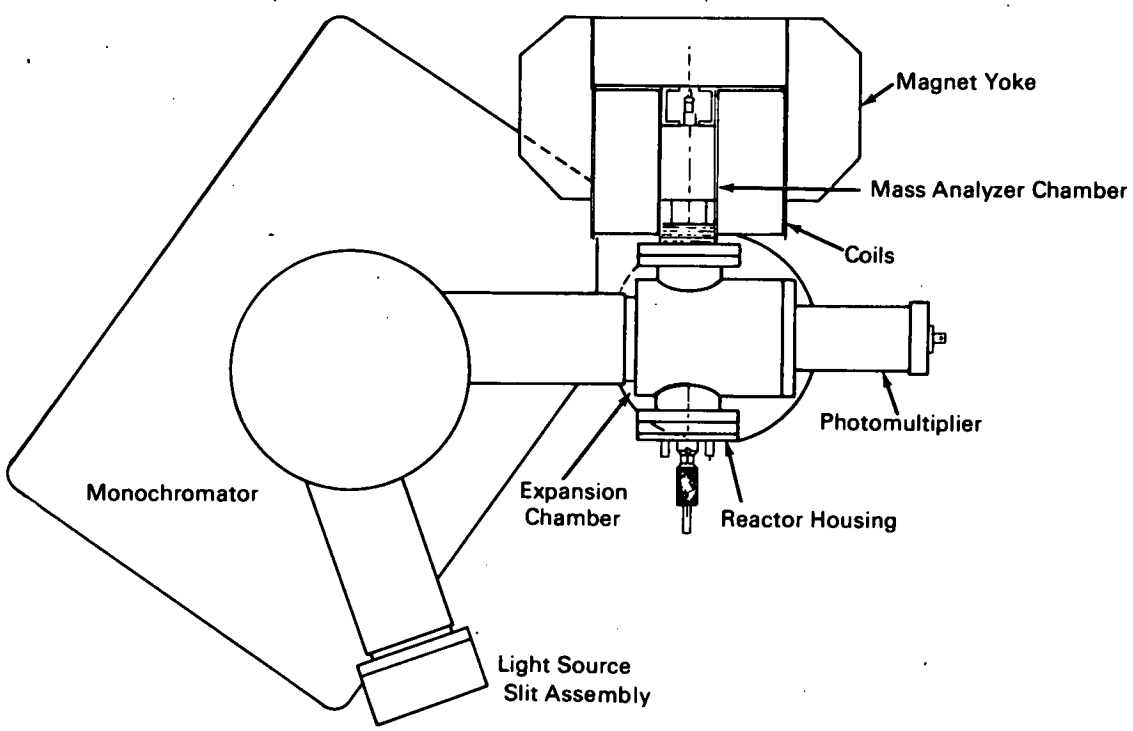
Brief 70-10113

NASA TECH BRIEF

Photoionization Mass Spectrometer



The problem:

The practical significance of ion-neutral reactions in diverse scientific areas such as radiation chemistry, upper-atmosphere physics and mass spectrometry has stimulated numerous investigations concerned with ion reaction kinetics. The conventional instrumentation employed in these studies consists of a mass spectrometer with a high-pressure electron-impact ion source. Unfortunately, the electron impact creates ions of different types due to ion fragmentation. The subsequent reaction kinetics are sufficiently complex to prevent an unambiguous assignment of reaction paths and individual rate constants unless the electron energies are close to the ionization threshold.

The solution:

An experimental system has been developed which uses a photoionization source with a vacuum uv monochromator. The monochromator is tuned to pass only the photon energies near the threshold of the selected ionization process.

How it's done:

The instrumentation, shown in the figure, consists of a pulsed light source, a one-half meter monochro-

(continued overleaf)

mator, a cylindrical ion source located at the monochromator exit, a 180° magnetic analyzer with a wedge-shaped air gap providing stigmatic focussing, and the necessary support electronics. Differential pumping is employed to achieve ion-source pressures up to 200 microns, while keeping the analyzer pressure in the 10^{-6} Torr range and the monochromator chamber pressure at about 10^{-4} Torr.

A cylindrical ion source is used with ion extraction occurring in axial direction through a 0.7 mm-diameter orifice. A biased repeller plate provides the necessary extraction field. Photoions are formed along the plane of the light beam perpendicular to the cylinder axis; the center of ion formation is located 3 mm away from the extraction orifice. With the optical entrance slit to the source in focal position and with the slit bars adjusted to a width of 0.25 mm, the average width of the light beam inside the source is 0.6 mm. The resulting spectral resolution is approximately 5 Å. Subsequent optical slits are wide enough so that the release of photoelectrons from light striking the walls is avoided. Photoelectrons produced at the confining slit are prevented from entering the source by means of a small auxiliary field.

The gas pressure in the ion source is measured directly with a McLeod gauge through the hollow stem of the repeller. Gases enter the source through the circular gap between the repeller plate and the surrounding walls and leave the source mainly through the light-beam exit slit. Flow and pressure of the research-quality gases are adjusted by leak valves; cold traps are used to remove moisture from the gases. Errors in the pressure determination, caused by the mercury vapor stream effect, were not corrected since they were generally smaller than other experimental errors.

Note:

The following documentation may be obtained from:

Clearinghouse for Federal Scientific
and Technical Information
Springfield, Virginia 22151
Single document price $3.00
(or microfiche $0.65)

Reference: NASA CR-84871 (N67-28934),
Laboratory and Theoretical Investigation
of Chemical Release Experiment

Patent status:

Inquiries about obtaining rights to the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

Source: Peter Warneck of
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