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3,192,383

MASS SPECTROMETER ION COLLECTOR WITH A SECONDARY PARTICLE
COLLECTING ELECTRODE EXTENDING OVER THE COLLECTOR
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Fig. 1.

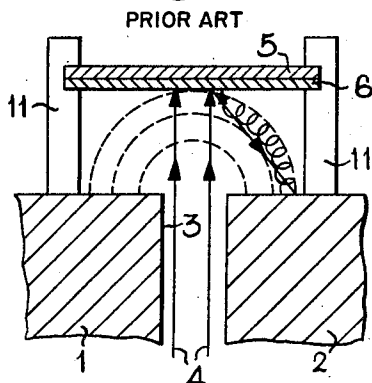
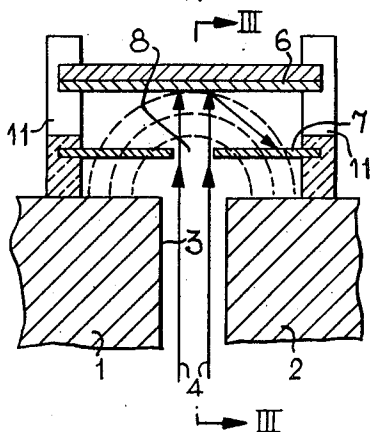


Fig. 2.

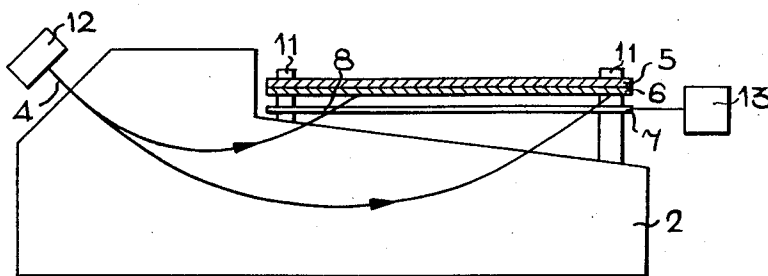


Fig. 3.

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MASS SPECTROMETER ION COLLECTOR WITH A SECONDARY PARTICLE COLLECTING ELECTRODE EXTENDING OVER THE COLLECTOR

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2 Claims. (Cl. 250—41.9)

The present invention relates to mass spectrometers and in particular to apparatus for collecting ions after they have passed through the magnetic analyser of a mass spectrometer and means for suppressing adverse effects due to secondary emission in the collecting apparatus.

In a mass spectrometer primary ions are produced from a sample to be analysed and are formed into a beam and projected into a magnetic field formed between the poles of a magnet in the magnetic analyser. Each ion is deflected on passage through this magnetic field in accordance with its mass/charge ratio and if the sample produces ions of different masses the beam of ions will be dispersed into a spectrum.

In order to detect ions of different mass/charge ratio it is convenient to use collecting apparatus including a sensitive plate to receive the dispersed beam. Ions of different mass/charge ratios strike this plate and form marks at different positions on the plate. By subsequent examination of the sensitive plate, the number of ions of any mass/charge ratio which strike the plate can be determined.

When a primary ion strikes the sensitive plate several secondary effects occur. Ions, neutral particles, photons and electrons may be emitted from the plate and there is a buildup of electric charge on the surface of the plate. The neutral particles and the photons travel in straight lines in random directions and the ions travel in curved paths and at least some of these will eventually strike the magnet poles where tertiary electrons will be emitted.

These tertiary electrons, under the combined actions of the magnetic field and the electric field produced between the sensitive plate and the magnet poles, which are conveniently grounded, travel towards the sensitive plate and strike this plate at positions different from that at which the primary ion struck.

This results in additional marks being formed on the sensitive plate in the vicinity of the mark formed by the primary ion and these additional marks may totally or partially mask marks produced by other primary ions. This effect particularly occurs when a primary ion beam of high intensity is received by the sensitive plate. As a result the sensitivity of the mass spectrometer to detect primary ion beams of low intensity in the region of a primary ion beam of high intensity is appreciably reduced.

The object of the present invention is to provide an improved form of mass spectrometer ion collecting apparatus which tends to avoid the above disadvantages.

According to the present invention a mass spectrometer ion collecting apparatus comprises a collector member having a surface coated with a layer of material sensitive to ions, an electrode extending over said layer and spaced therefrom, means for applying a positive potential to said electrode so that it attracts negatively charged secondary particles emitted from said sensitive layer when primary ions strike said layer, and a slit extending along said electrode to allow the passage of primary ions on to said sensitive layer.

When the collecting apparatus is used in combination with the magnetic analyser of a mass spectrometer, the electrode prevents most of the secondary particles emitted from the sensitive surface by incident primary ions from

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striking the surfaces of the magnetic analyser magnet poles and attracts any tertiary electrons emitted from the electrode itself or from the surfaces of the magnet poles.

In order that the invention may be more readily understood reference will now be made to the accompanying drawing in which:

FIG. 1 is an end view, in section, of part of the magnetic analyser of a mass spectrometer;

FIG. 2 is an end view of the magnetic analyser illustrated in FIG. 1 including collecting apparatus in accordance with the invention; and

FIG. 3 is a side view sectioned on the plane III—III of the magnetic analyser illustrated in FIG. 2.

With reference to FIG. 1 the magnetic analyser comprises two magnet poles 1, 2 defining a gap 3 through which a beam 4 of primary ions passes. The ions in the beam are deflected in accordance with their mass/charge ratio in the manner described above as they pass through the magnetic field. The magnetic analyser is used in combination with collecting apparatus comprising a plate 5 supported on insulating supports 11 from the poles and coated with a layer 6 of material which is sensitive to ions. This material may be photosensitive emulsion.

When the primary ions strike the free surface of the layer 6 a positive charge is formed on this surface and ions, neutral particles, photons and electrons may be emitted from the surface. The neutral particles and photons travel in straight lines in random directions, and at least some will strike the top surface of one of the magnet poles. Some of the emitted ions will also travel in curved paths to strike the surface of one of the magnet poles. Tertiary electrons may then be emitted from the magnet poles and these tertiary electrons will come under the combined effects of the magnetic field produced by the magnet poles and the electric field produced between the charged surface of the layer 6 and the magnet poles which are conveniently at ground potential.

The lines of force of the magnetic field extend in approximately circular paths as shown while the lines of force of the electric field extend directly between the layer 6 and the poles 1, 2. The tertiary electrons will therefore travel in helical paths towards the layer 6 and will eventually strike the layer 6 producing additional marks on the sensitive layer.

FIGS. 2, 3 illustrate a modified magnetic analyser incorporating collecting apparatus in accordance with the invention. An electrode 7 is supported between the layer 6 on supports 11 and the poles 1, 2 and extends along the full length of the layer 6 substantially parallel thereto. The electrode is formed with a longitudinal slit 8 which permits the primary ion beam from an ion source 12 to pass through the electrode and strike the sensitive layer 6. The electrode is maintained at a positive potential relative to the layer 6, for example 300 volts, from a source 13.

With this modified construction ions, photons, and neutral particles emitted from the layer 6 are intercepted by the electrode and are prevented from striking the top surfaces of the poles 1, 2. Also the potential applied to the electrode is chosen so that the electrode attracts secondary electrons emitted from the layer 6 and tertiary electrons emitted from the electrode when the ions, photons and the neutral particles strike its surface. The electrode also attracts any tertiary electrons which are emitted from the surfaces of the poles by any particles striking these surfaces.

With collecting apparatus in accordance with the invention secondary and tertiary particles are substantially prevented from striking the surface of the sensitive layer and therefore the sensitivity of the apparatus is not reduced by the formation of additional marks on the sensitive layer.

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In the arrangement illustrated in the figures, the plate 5 is fixed in position. In an alternative arrangement the plate is not held rigidly by the supports 11 so that the plate can be moved transversely relative to the path of the ion beam and different portions of the sensitive layer 6 can be exposed to the ion beam.

What I claim is:

1. A mass spectrometer ion collecting apparatus comprising a collector member including a layer of photo-sensitive material that is sensitive to ions, an electrode extending over said sensitive layer and spaced therefrom, means for applying to said electrode a potential positive with respect to the potential of said sensitive layer so that said electrode attracts negatively charged secondary particles emitted from the sensitive layer when primary ions strike said sensitive layer, and surfaces to said electrodes defining a slit extending through said electrode to allow the passage of primary ions to said sensitive layer.

2. A mass spectrometer ion collecting apparatus comprising a collector member including a layer of photo-sensitive material that is sensitive to ions, an electrode

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extending over said sensitive layer and spaced therefrom and formed with a surface extending substantially parallel to said layer, means for applying to said electrode a potential positive with respect to the potential of said sensitive layer so that said electrode attracts negatively charged secondary particles emitted from the sensitive layer when primary ions strike said sensitive layer, and surfaces to said electrode defining a slit extending through said electrode to allow the passage of primary ions to said sensitive layer.

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20 RALPH G. NILSON, *Primary Examiner*.