ELECTRON CAPTURE DETECTOR SYSTEMS

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ABSTRACT

Two electron capture detectors are connected together such that a gas flows through the first detector and then into the second detector. The potential across the first detector is switched regularly between maximum and minimum values and the signal derived from the second detector is modulated by this switching action whenever a strong electron absorber is present in the gas flow.

3 Claims, 1 Drawing Figure
ELECTRON CAPTURE DETECTOR SYSTEMS

This is a continuation of application Ser. No. 278,411 filed Aug. 7, 1972, and now abandoned.

1. The present invention relates to electron capture detector systems.

An electron capture detector comprises an ionization chamber having spaced apart electrodes and a source of ionizing radiation located within the chamber. Upon entry of a gas possessing no affinity for electrons into the chamber, recombination of positive ions and free electrons is unlikely to take place because of the high mobility of the free electrons. Thus by applying a potential across the chamber all ions formed by the ionizing radiation can be collected. When the gas contains a substance having an affinity for electrons negative ion formation occurs which is accompanied by an observed decrease in current.

The presence of extraneous weakly absorbing substances in the gas flow through the detector can interfere with or prevent the correct functioning of the detector and an object of the invention is to overcome this difficulty.

According to the present invention an electron capture detector system comprises two electron capture detectors electrically insulated the one from the other and coupled together in series such that gas entering the first detector and then the second detector, means being provided for varying the potential applied across the electrodes of the first detector between zero and maximum values and means for detecting an output signal from the second detector.

The invention will be described further, by way of example, with reference to the accompanying diagrammatic drawing of an electron capture detector system.

In the drawing reference letters A and B denote two electron capture detectors coupled together such that gas entering A through an inlet passes through A and enters B before exhausting at an outlet from B. The detectors A and B are electrically insulated the one from the other as denoted at C. Detector B is connected to an amplifier or other electronic system. The operation of detector B can be by a DC polarising potential, by pulses or by a frequency modulated procedure.

Detector A is arranged to be polarised either with a high DC potential, for example 100 volts, which is sufficient to remove all electrons present in an incoming gas, or with zero potential whereby the free electron concentration in the gas can be the maximum possible. If a strong electron absorber is present in the incoming gas no ionisation i.e. production of negative ions, will occur in detector A when a high potential is applied thereto and detector B will respond as if detector A was absent. However when detector A is at zero or a low potential then the reaction between the free electrons and the electron absorbing substance in the gas will remove electrons (and thus in effect the absorbing substance) from the gas. Detector B will in such a case indicate an increased signal.

The system can be used to distinguish a weak from a strong electron absorbing substance. The system can thus be used in the identification of such substances. If the potential on detector A is switched regularly between zero and high potential, at for example one or more cycles per second, then the signal at the second detector B will be modulated by this switching cycle whenever a strong electron absorber is present in the gas entering detector A. The drawing shows a circuit arrangement of the two detectors and includes a synchronous converter to rectify the alternating signal from detector B.

The system provides a number of advantages, of which the following are cited as examples.

In the analysis by gas chromatography of low levels of strongly absorbing substances such as pesticides and atmospheric tracers, the presence of moderate concentrations of weakly absorbing substances can interfere with or even prevent analysis. The present system incorporating two detectors is not sensitive to weakly absorbing substances provided that the electron concentration in the two detectors is not so far reduced by the presence of the weak absorber as to prevent the detection of the strong electron absorber. Subject to this condition the presence of weakly absorbing substances, such as oxygen, give no detectable or adverse effect.

The synchronous production, amplification and rectification of the signal results in an improvement in stability and a reduction in noise level.

Alpha emitting radio-active sources, such as Am 241, give intense ionisation with only a small amount of radio-active material. However the resulting increase in noise level prevents the use of such sources in conventional electron capture systems. This restriction is avoided by the present system.

I claim:

1. An electron capture detector system, for detecting the presence of an electron absorber in a gas sample, comprising in combination:

   first and second electron capture detectors electrically insulated the one from the other, said first and second detectors being coupled together in series such that the gas sample flows through the first detector and then through the second detector, said first detector including electrodes for receiving a potential, said second detector including means for producing an output signal, means periodically switching the potential applied across the electrodes of the first detector between minimum and maximum values for modulating the output signal of the second detector in response to presence of an electron absorber in the gas sample, and means for detecting the output signal from the second detector, said second detector including electrodes, said means for producing an output signal including means applying a polarizing potential to said second detector electrodes, said output signal of said second detector being an alternating signal, said means for detecting the output signal including a synchronous converter for rectifying said alternating signal from said second detector.

2. An electron capture detector system, for detecting the presence of an electron absorber in a gas sample, comprising in combination:

   first and second electron capture detectors electrically insulated the one from the other, said first and second detectors being coupled together in series such that the gas sample flows through the first detector and then through the second detector, said first detector including electrodes for receiving a potential, said second detector including means for producing an output signal, means periodically switching the potential applied across the electrodes of the first detector between minimum and maximum values for modulating the output signal
of the second detector in response to presence of an electron absorber in the gas sample, and means for detecting the output signal from the second detector, said periodically switching means comprising a low frequency generator and means coupling same across the electrodes of said first detector, said means for detecting the output signal including a synchronous converter coupled to said low frequency generator, said second detector including further electrodes, said synchronous converter being coupled further to one of said second detector electrodes for rectifying the alternating output signal from the second detector.

3. The system of claim 2 in which said minimum and maximum values correspond, respectively, to a first potential wherein the free electron concentration in the ionized gas sample is maximized and to a second potential wherein substantially all free electrons present in the ionized gas sample are removed therefrom by said first detector electrodes.

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