Gaseous detector device for an environmental electron probe microanalyzer (G D Danilatos, CSIRO Division of Textile Physics)

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Research Disclosure Database Number 233011
(Research Disclosure Journal Number : 23311)

Published in September 1983

Research Disclosure Journal, ISSN 0374-4353. © Kenneth Mason Publications Ltd
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23311

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ABSTRACT

The electron beam in instruments such as electron microscopes or general electron probe micro-analyzers (EPMA) interacts with the specimen generating as a result a variety of signals such as secondary electrons, backscattered electrons, transmitted electrons, X-rays, cathodoluminescence or absorbed current. Each of these signals is detected by appropriate detection means (detectors).

In conventional electron microscopy, both the electron beam and the specimen under examination are under high vacuum. However, it is possible to examine the specimen inside a gaseous environment if special known techniques[1] are employed to separate the high pressure region of the specimen from the high vacuum of the electron optics column.

It has now been found that the gas itself in an environmental EPMA can be used for the detection of signals. Signals capable of ionizing the gas create positive and negative charges which can be collected and monitored by suitable means. For example, a wire inserted in the gaseous environment and biased with a positive or negative voltage can collect the negative or positive charges (ions) and transmit a current into a video display, corresponding to the properties of the area of interaction between the electron beam and the specimen. Images of specimens have been produced in the environmental scanning electron microscope by using the ions produced by the ionizing signals. These images can correspond to the backscattered electron images at a certain gas pressure, but additional information appears as the gas pressure varies. The information on the images varies as different signals are detected with variation in the electrode configuration, bias, gas constitution and gas pressure.

In addition, the presence of gaseous and liquid phases around the specimen has made possible the recording of data from both insulators and conductors using the absorbed current mode of detection.

The main advantage of the gaseous detector device over the known detectors is that the gas can serve as a conditioning medium at the same time. Thus the specimens can be maintained at their natural state, they can be liquids, or they can take part in a physical or chemical reaction during their examination under the electron beam.

Again, various signals can be detected simultaneously. To achieve a similar result with conventional detectors, it is necessary to adapt separately each of these detectors for operation in the presence of gas. Such adaptation, however, is not always possible or practical. A further advantage is the extreme simplicity of the device.

REFERENCE

[1] Danilatos GD, Design and Construction of an Atmospheric or Environmental SEM, (Part 1), Scanning, *4*, 9-20 (1981).

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