

ISSN 0020-4412

*Scienc*

Vol. 28, No. 1, Part 2, January-February, 1985

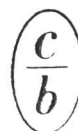
August, 1985

INETAK 28(1) 131-264 (1985)

# **INSTRUMENTS AND EXPERIMENTAL TECHNIQUES**

ПРИБОРЫ И ТЕХНИКА ЭКСПЕРИМЕНТА  
(PRIBORY I TEKHNIKA ÉKSPERIMENTA)

TRANSLATED FROM RUSSIAN



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Although the discharge within an individual nozzle is inhomogeneous (one sees a zone of elevated emission in the aerodynamic wake behind the cathodes), the reduced scale of an individual component goes with the turbulent mixing in the outgoing gas to produce a reasonably homogeneous flow at the exit from the nozzle array.

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#### THE ONE-ELECTRON PULSE-HEIGHT RESOLUTION AS A CHARACTERISTIC OF OPEN-TYPE SECONDARY ELECTRON MULTIPLIERS

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UDC 539.1.074

The paper discusses using the one-electron pulse-height resolution to describe the properties of open-type secondary-electron multipliers, and an example is given of the incorrect use of this. It is pointed out that the one-electron pulse-height resolution is a characteristic of the pulse-height distribution obtained on recording particles that on first collision in the secondary-electron multiplier can produce only one secondary electron each.

It is necessary to know the characteristics of secondary-electron multipliers (SEM) in order to use them correctly and effectively [1, 2]. The basic characteristics are the gain  $K$ , by which is meant the height of the most likely pulse at the output, and the pulse-height resolution, which is defined as the ratio of the width of the pulse-height distribution (PHD) at half height to the most likely pulse height (here and subsequently, it is assumed that the PHD has a quasi-Gaussian form).

An SEM may be used under various conditions and to record various particles. Naturally, the characteristics may differ substantially. In order to derive a parameter independent of the detailed conditions that enables one to compare SEM of different types and from different makers, one can use the one-electron pulse-height distribution (OEPD), which is widely used to determine the performance of photomultipliers (PM). The OEPD characterizes the pulse-height distribution at the output from a PM in recording photons, which can produce only one photoelectron each at the photocathode [3]. Therefore, the OEPD characterizes not only the multiplying part of the PM, which may be an SEM of open type, but also the configuration and strength of the electric field between the photocathode and the multiplying part, i.e., it is a characteristic of the PHD obtained on recording particles (protons) that on reaching the detector they can produce only one secondary electron each (photoelectron).

When an open-type SEM is used to record particles, the OEPD should be used to characterize the performance. In [2, 4], for example, this term is used to characterize the PHD obtained on recording a weak electron flux, when one considers that the electrons reach the SEM individually. However, this use of the OEPD is incorrect, since it makes the characteristics substantially dependent on the electron energy in particular.

It is clear for example that it is much simpler and requires a lower supply voltage to record of energy 300 eV than it does for electrons of much lower energy, as one can obtain a high  $K$ , a saturation state, and a narrow PHD, i.e., good SEM characteristics, for example, with microchannel plates (MCP), with a corresponding good performance evaluation. This occurs because the secondary-electron emission coefficient of electrons of energy 300 eV incident at  $30^\circ$  to the normal of the glass used to make MCP is about three [5], whereas the arrival of electrons of low energy is equivalent to recording particles with a secondary-electron emission coefficient of one.

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Space Research Institute, Academy of Sciences of the USSR, Moscow. Translated from *Pribery i Tekhnika Éksperimenta*, No. 1, pp. 144-146, January-February, 1985. Original article submitted September 9, 1983.

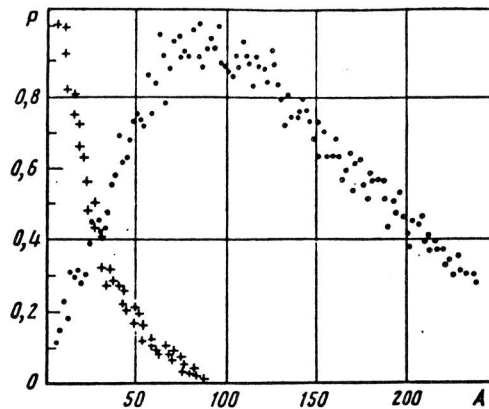


Fig. 1. Height distribution for the pulses recorded with a VÉU-7 on photons of wavelength 147 nm (crosses) and He<sup>+</sup> ions of energy 5000 eV (points). Voltages on the MCP 900 V each, voltage between the MCP 15 V. A pulse height, P relative probability of a pulse with the given height. The curves have been normalized to the maxima.

This is illustrated by the PHD obtained with a set of two MCP type VÉU-7 placed in sequence [6] on recording ultraviolet photons of wavelength 147 nm and He<sup>+</sup> ions of energy 5000 eV (Fig. 1). The photons on first collision can produce only one secondary electron each (photoelectron), while an ion can produce several. It is evident that the VÉU-7 works in the saturated state in recording ions, whereas it operates in the substantially unsaturated state in recording photons (one-electron mode). Also, the OEPD given by the maker of the VÉU-7 relates to the recording of electrons of energy 400 eV, i.e., not to the one-electron state.

The use of the OEPD made in [2, 4] is essentially incorrect. In the case of a PM, the OEPD enables one to ignore the nature of the photons, the only point being that they produce only one secondary electron (photoelectron) each on entering the detector. It is logical also to apply the OEPD to SEM of open type. By OEPD one should understand the PHD characteristic obtained on recording particles that on entering the detector produce only one secondary electron each. This formulation transfers correctly the OEPD term from PM to SEM of open type and enables one to ignore the detailed form of the input particles.

Measurements may be made on the OEPD by recording photons of energy sufficient to eject only one electron each.

This topic is important from the practical viewpoint for users of SEM, since incorrect use of the OEPD may lead to the characteristics given by the maker being overestimated, which in turn may lead to difficulties or to incorrect use of the SEM.

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