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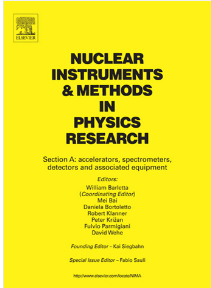

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CALIBRATION PROCEDURE IN MICROCHANNEL AMPLIFIERS DESIGN

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Abstract

The main parameters of microchannel amplifiers - angular and energy distributions of photo- and secondary electron emission - are determined by the emission properties of materials. These parameters depend on the type of materials, the thickness of deposited films and the technology of processing their surfaces. Data on the emission properties of materials can be obtained by means of experimental measurements or by calculation methods using molecular dynamics. In both cases, this is associated with significant resource costs. In the cases where some of these characteristics of the materials are unknown, a calibration procedure can be recommended to determine them. Details of this procedure are described in this paper. Comparison of numerical and experimental data for specific devices is performed.

Keywords: Photo detector; Micro channel plate; Numerical simulation

1. INTRODUCTION

Microchannel amplifiers are widely used in astrophysics, medical diagnostics, accelerator physics, and night vision devices. They have many advantages: compactness, high gain, stable operation in radiation and in strong magnetic fields. An amplifier consists of a photo cathode, one or more microchannel plates (MCP), an anode structure and high speed electronic circuits that process signals at the output of the amplifier. Theoretical background of microchannel amplifier simulations is described in ref. [1]. The computer simulation consists of two independent phases: microscopic modeling and computation of the amplifier parameters.

The microscopic phase should determine the emission properties of materials used in the device. First, a parameterized set of the secondary emission yield (SEY) dependencies in two variables, the energy of the primary electron and the angle of incident electrons for lead glass should be developed. This parameterization can be done by using results obtained from Monte Carlo calculations or from experimental measurements. As a result, it is necessary to obtain the angular and energy distributions for secondary emission coefficient, as the parameters of the electron flux incident on the surface of the material. Experimental measurements for the required characteristics are associated with considerable time and resources of the measuring complex. It takes about three months for one sample [2-9].

The other way to get these data is computer simulation based on Monte-Carlo algorithms for the numerical models of molecular dynamics [10-14]. An example of numerical simulation using the code "CASINO" [15] is shown in Fig. 1, where a beam of 10^5 electrons with random initial data falls on the surface with random positions of atoms at the angle of 45^o. Random data should represent the statistical properties of the interaction of a particle beam in the surface layer

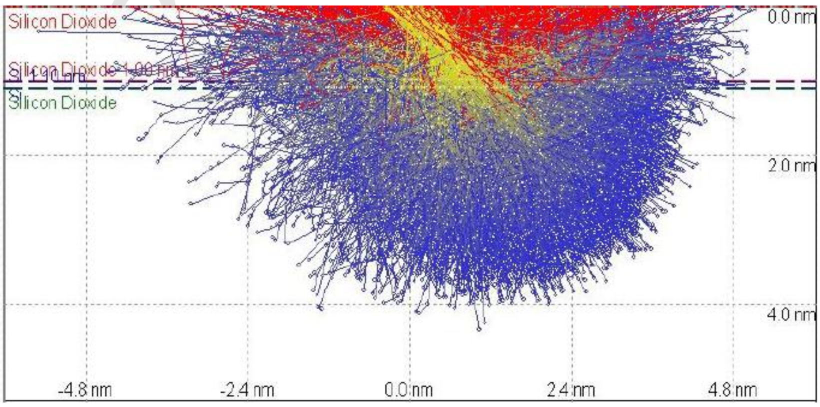

Figure 1. Electron trajectories passing through a SiO2 multi-layer structure. Color shows the particle energy.

of the material.

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