

Experimental study of application of the self-calibration method to certify absolute spectral sensitivity of a scintillation counter in the soft X-ray range.

A.D. Nikolenko¹, V. F. Pindyurin, V. A. Chernov, V.V. Lyakh.
Budker Institute of Nuclear Physics, 630090 Novosibirsk, Russian Federation

The self-calibration method earlier has been successfully developed by the PTB team (Berlin, Germany) for absolute certification of spectral sensitivity of semiconductor diodes [1, 2]. In these works, parameters required to determine spectral sensitivity of a detector (the dead layer on the surface of detector and sensitive area thickness) were found via measuring the spectral response of the detector at different angles of radiation incidence on the receiving surface of the detector.

In the case of absolute calibration of a scintillation counter (SC), the spectral sensitivity of the detector is described with a slightly more complicated model. Beside the dead layer thickness, the model includes the spectral efficiency of the scintillator, the efficiency of collection of visible photons on the photo-cathode, the photo-cathode efficiency and particularities of signal amplification by the dynode system of the photomultiplier. The present work describes the preliminary measurement of the spectral sensitivity of a SC based on a photomultiplier with guaranteed one-electron peak FEU-130 with a YAP scintillator. The dead layer thickness of the scintillator was determined in the same way as in [1, 2]. The efficiency of registration of X-ray photons that passed the dead layer of scintillator is found by the form of the amplitude spectrum of anode pulses of the photomultiplier.

The evident explanation of this technique briefly can be described as follows: x-ray quantum absorbed by the scintillator, is generated the light flash, which is registered by the photoelectron multiplier (PEM). In case of soft x-ray photon the number of the visible photons in each flare is not big (from units up to several tens depending on energy of x-ray photon and characteristics of scintillator) and

consequently the significant part of useful pulses of PEM is situated in the one-electron peak. It means, that the average number of optical photons, be registered by the PEM from the such flash, is less then 1. Nevertheless, in a amplitude spectrum of pulse signal of PEM, we can observe not only one-electron peak, but also the effect of presence of two- and three-electron peaks. Using the relative intensity of these peaks we can to calculate the probability of registration of every x-ray photon which has penetrated through a dead layer and was registered in the scintillator.

This method does not allow one to separate the contribution of each of the SC parameters that influence its efficiency but it gives the absolute efficiency of a particular SC. The advantage of this method is that all the measurements are relative ones and can be performed on any available source of monochromatic soft X-radiation. A disadvantage of the method is its low accuracy (estimated to be not better than 10%).

The experimental checking of this method were performed at the Soft X-ray metrology station at the VEPP-3 storage ring for the few different energy of photons from 100 to 1500 eV. In the near future, as expect, the station is to be equipped with reference detectors with a calibrated spectral sensitivity, which will allow one to check correctness of calibration.

1. Krumrey M., Tegeler E., *Rev. Sci. Instrum.* 1992 **63**, 797-801
2. Krumrey M., Tegeler E., *Nuclear Instruments and Methods in Physics Research A* **288** (1990) 114-118

¹ A.D.Nikolenko@inp.nsk.su