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CATHODOLUMINESCENCE AND RADIATION OF VAVILOV-CHERENKOV IN DIAMOND UNDER THE ACTION OF AN ELECTRON BEAM WITH AN ENERGY UP TO 300 KEV*

A.A. KRYLOV[1,2], *A.G. BURACHENKO*[1,2]

[1]*Institute of high current electronics SB RAS, Tomsk, Russia*
[2]*National research Tomsk state university, Tomsk, Russia*

Various detectors are used to register high-energy charged particles, among which a detector operating on the basis of the Cherenkov effect can be distinguished [1, 2]. Unlike other types of detectors, Cherenkov detectors (CD) have a number of advantages and are widely used in such fields of science and technology as high energy physics, astrophysics and nuclear physics. As a rule, CD is used to register charged particles, in particular electrons, with an energy of tens to hundreds of MeV and higher. At such electron energies, the luminescence level of the medium (radiator) in which the Cherenkov radiation (CR) occurs is small, and in most cases it can be ignored. However, there are areas of CD application where it is necessary to register electron fluxes with an energy of tens to hundreds of keV, for example, in controlled thermonuclear fusion installations of the tokamak type. It is also known that high temperatures are reached during the operation of the tokamak, which imposes restrictions on the choice of CD radiator material. One of the promising materials of the CD radiator used in tokamaks, which has high temperature and radiation resistance, is diamond. In addition, the diamond has a relatively low threshold energy of the occurrence of the CR ~ 50 keV due to the high refractive index (n = 2.42), as well as transparency in the UV region of the spectrum, where the intensity of the CR is maximum. However, when exposed to an electron beam with an energy of tens to hundreds of keV, cathodoluminescence (CL) may occur in the radiator material in addition to the CR which will distort the signal of the Cherenkov detector. Therefore, to register electron beams with an energy of tens to hundreds of keV, it is important to know the contribution of CL to the luminescence spectrum of the CD radiator material.

The aim of the work is to study the spectral characteristics of the radiation of diamond samples under the action of an electron beam with an energy of tens to hundreds of keV (up to 300 keV).

The excitation of the radiation of various diamond samples was carried out using a NORA generator with a soldered IMA3-150E electron tube. The energy spectrum of the electron beam for this generator was in the range of 30-300 keV.

The spectral characteristics of the luminescence of various diamond samples, as well as the impurity-defect composition of these samples were studied by Raman spectroscopy. As a result of these studies, diamond samples were selected that are most suitable for the registration of CR. The calculated CR spectra were compared with the obtained experimental luminescence spectra of diamond samples under the action of an electron beam with an energy of up to 300 keV.

It is shown that, when registering an CR in a diamond, it is necessary to take into account the contribution of CL to the signal of the Cherenkov detector when excited by an electron beam with an energy of up to 300 keV.

REFERENCES

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