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DEVICE FOR ESTIMATION OF CURRENT AND ENERGY DENSITY DISTRIBUTION IN THE CROSS SECTION OF A PULSED SUBMICROSECOND ELECTRON BEAM *

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The research and practical application of electron beams [1–3] requires the measurement and control of the electron beam parameters in the area of its use. A sectioned calorimeter combined with a detector of the total electron beam current was developed for estimation of the charge and energy density distribution in the beam cross section.

The paper presents the features of the development, test results and description of the sectioned calorimeter modification, which collector is also the collector of the integral Faraday cup. The design of the device, its diagnostic and software equipment [4] make it possible to estimate the average kinetic energy of beam electrons in one measurement procedure.

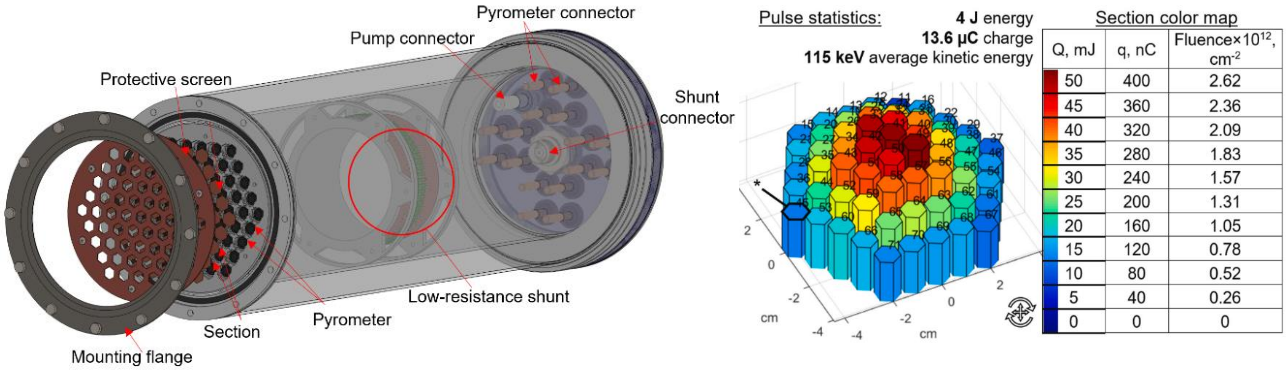

Fig.1. External view of the developed device without conductors (a) and measurement example of distribution of beam energy Q, charge q, and fluence across the calorimeter's collector (b) [5].

The calorimeter consists of a collector with isolated sections and an array of non-contact thermal sensors (pyrometers). The developed software controls the array of pyrometers and calculates the energy released in each section of the collector. The current detector monitors the total electron beam current through the electrical connection of each section to a low resistance shunt. The signal is detected by an oscilloscope to calculate the charge. Thus, the charge distribution is estimated in proportion to the energy distribution for a monoenergetic electron beam.

The set of the calorimeter characteristics makes it possible to measure the energy distribution in the cross section of pulsed electron beams with an electron kinetic energy of up to 700 keV, an energy density of up to 3.6 J/cm^2, and a total beam energy of up to 50 J/pulse. The design of the device allows measurements under various vacuum conditions: discrete with a separating membrane and with joint pumping; as well as under various beam transportation conditions: in gases and in vacuum (up to 10^{-5} Torr).

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