Development of Methods and Technologies OF BOLOMETRIC diagnosiCs

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Bolometric diagnostics is one of the main monitoring diagnostics on the vast majority of plasma physics facilities with high-temperature plasma.

Historically, domestic tokamaks use currently two types of bolometric sensors: photodiodes and pyroelectric sensors. In foreign machines are also widely used a metal-foil bolometers. In light of the particular relevance of the study of thermal conditions of the divertor, there is expanding the combined use of bolometers and various types of CCD-cameras to measure the radiative losses and surface temperature of wall areas, working in extreme conditions.

However, it should be noted that each type has its own characteristic of bolometers drawbacks: photodiodes have characteristic dips in the spectral sensitivity, pyroelectrics can not measure constant signal, and its are sensitive to the acoustics, metal-foil bolometers are expensive and low-frequency [1].

This report describes a new type of sensor for the bolometers, as well as the methods of measurement and calibration bolometers to expand diagnostic capabilities.

The new sensor is composed of a thin carbon film deposited on a silicon plate. The film thickness is less than several nanometers, whereby it has the features of reduced dimensionality, i.e. it is a quasi-2D rather than 3D object. It can be used as a bolometer due to the effect of significant changes in the longitudinal conductivity of the film when it is irradiated in the infrared, visible and ultraviolet range. A wide range of absorption of external radiation is determined by the characteristic spectrum of the electronic states of nano-sized carbon coating.

Development of measurement methods represented by usage of an active circuit with a carrier frequency supplied to the sensor and the subsequent on-line processing of the response instead of passive measurements of the sensor signal using a preamp [2].

Development of methods of calibration involves taking into account nonlinearity of sensors along the spectrum, the amplitude and in the apparatus function. To do this a single calibration factor values of each measurement channel are substituted by the selected functional dependence of the calibration factors on the current value of raw signal, and some of its previous data. The functional dependence of the calibration coefficients and coefficients in it is carried out by a symbolic regression.

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References

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