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CHARACTRERIZATION OF BENT MICA MONOCHROMATOR USED FOR REGISTRATION OF X-RAY EMISSION FROM HIGH TEMPERATURE PLASMA *)

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High temperature plasma is intensive source of x-ray lines emitted by highly ionized ions. Relative intensities of x-ray lines from helium-and hydrogen like ions is an effective instrument to estimate electron density, electron and ion temperature, allows to draw conclusions on the presence of electromagnetic fields, velocities of fast particles, etc. Registration of spectra with high spectral and spatial resolution is carried out with focusing x-ray spectrometers, the key element of which are bent monochromators: quartz, Si, Ge, mica. Accuracy of determination of plasma parameters depends on the quality of monochromators. Since the energies of diagnostic lines are very close to each other it is usually assumed that their reflection coefficients are equal. However, in many experiments the reflection of two lines takes place from different crystal areas [1]. Obviously, homogeneity of diffraction properties of bent monochromators depends on fabrication technology, so needs verification even for flat thin samples [2].

This report is devoted to investigation of homogeneity of reflection of two mica samples with the sizes 25×70 mm^2 ,110 μ thickness, glued to spherical substrate R250 mm. Experiments are carried out at SmartLab (Rigaku, Japan). Figure shows crystal -monochromator mounted on the goniometer in the center, x-ray source is on the left, detector - on the right. Measurements are done in the third reflection order of K_α Cu (Bragg angle θ=13.36º) in the parallel beam with the divergency 0.04-0.05º. Diffraction curve registered with the step 2 mm and 4 mm from the crystal area 0.2 mm×15 mm. Similar crystal area might be involved in the registration of spectra emitted by point-like sources (laser produced plasma, Z-pinch), while a distance between two crystal areas reflecting two lines might be equal to 2-3 mm.

Registered rocking curves are two orders of magnitude wider than those predicted for flat samples, 5-6 times wider than those given for concave mica samples [3]. The results obtained indicate inhomogeneity of diffraction properties of concave mica: local reflection coefficients might differ within 20% which is comparable with the accuracy of analytical methods of x-ray spectroscopy. The various reasons of inhomogeneity are: mosaicity of mica, adding additional stresses arising as a result of bending, the presence of glue layer of uncontrollable thickness. Detailed characterization of monochromators of x-ray spectrometers allows one to increase accuracy of estimation of parameters of high temperature plasma.

Reference

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*) abstracts of this report in Russian