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VISUAL CONTROL SYSTEM FOR STRIPPING FOILS OF NEUTRAL PARTICLE ANALYZERS AT ITER: DEVELOPMENT AND TESTING *)

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Stripping targets based on thin carbon foils are critical elements of atomic analyzers – devices of neutral particle diagnostics being developed for the ITER reactor [1]. The targets provide efficient conversion of the incoming atomic flux into a flux of charged particles, which are then separated by energy and mass in the electric and magnetic fields of the analyzers. Structurally, the target is a circular frame with a fine copper mesh fixed on it, on which a carbon foil of about 10 nm thick is applied. The stripping target is installed at the analyzer inlet, i.e., it is located on the axis of the straight vacuum channel directly connected to the plasma volume. Under conditions of the ITER reactor, it will be subjected to significant radiation loads; in addition, mechanical stresses may disrupt the intactness of the carbon foil. Since a change in the thickness or breaking the integrity of the target may cause a change in the detection efficiency of atomic fluxes, the analyzers provide for the possibility of quick replacement of the working target without breaking the vacuum by means of a special mechanism containing four additional spare targets. To determine if the target needs to be replaced, two systems for the control of the stripping target quality are included in the analyzer suite. One of them is based on the use of a compact ion source that forms a probe helium ion beam of a given intensity and energy [2]. The other system is designed for fast visual control of the foil intactness using a radiation-resistant video camera STS-40M manufactured by the "DIAKONT" company [3]. This report presents results obtained during the development and testing of the former system. The design of the system is considered and the possibility of determining visual defects of the stripping target is demonstrated. The main attention is paid to the problem of radiation resistance of the video camera and the LED backlight used. For these devices, the estimated values of the fast neutron fluence at ITER are $\sim 5\times10^{13}$ cm^{-2} and $\sim 5\times10^{14}$ cm^{-2}, respectively. Tests conducted on a fast neutron beam have shown that under such radiation conditions the visual control system remains functional.

References

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*) abstracts of this report in Russian