SPECTRAL DETERMINATION OF ELECTRONIC TEMPERATURE IN A MAGNETIZED LOW PRESSURE HELIUM DISCHARGE [[1]](#footnote-1)\*)

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1,2Kavyrshin D.I., 1Fedorovich S.D., 1,2Muraveva E.V., 1,2Chinnov V.F., 1,2Myazin A.S., 1Tran Q., 1Karpov A.V., 1Budaev V.P.

1NRU "MPEI", Moscow, Russia, [dimakav@rambler.ru](mailto:dimakav@rambler.ru),  
2JIHT RAS, Moscow, Russia, [v\_chinnov@oivtran.ru](mailto:v_chinnov@oivtran.ru).

We study electrical discharge in low-pressure helium with magnetic confinement on an experimental installation at MPEI called PLM (Plasma Linear Multicasp) [1]. The installation is a magnetic confinement with minimal magnetic field on its axis (up to 6 mT) where plasma is created by electron stream moving in a metallic tube-solenoid with inner diameter of 160 mm from thermal cathode to anode. Stationary helium plasma flow at camera pressure 10-1 ÷ 10-3 Torr, discharge current 2÷25 A, jet diameter 15÷17, jet length 400 mm and plasma voltage 100÷200 V provides heat load on the sample surface introduced into the axial region up to 10 MW/m2. Plasma parameters in the channel and sample interaction region were determined from optical emission spectra registered with three-channel AvaSpec-ULS2048 spectrometer in the wavelength range 200–1100 nm. The equation for intensity ratio of He II line to the intensity of one of the atomic lines derived under coronal approximation [2] has the following form:

 (1)

It allowed to determine plasma electron temperature with error about 10 % by comparing the experimentally obtained intensity ratios to the calculation result of (1). Our analysis has shown that emitting helium ions are highly sensitive indicators of average electron temperature *= 3kTe/2,* which is the kernel of electron distribution function over energies despite the complexity of the studied plasma which includes nonlocality of electron distribution function over energies, complex nature of charge drift and diffusion in crossing and inhomogeneous *E*x*H* fields, etc. Therefore, using the intensity ratios of the strongest emitting lines in Ultraviolet-Visible-near-Infrared range – He II 468.6 nm and several He I lines with well-known electron excitation functions [3] – was found to be a reliable spectral method for determining electron temperature of magnetized rarefied helium plasma. For the following experimental conditions: [He] ≈ 1014 см-3, discharge current 4.1 A and voltage drop 182 V the electron temperature measured from 3 singlet and 4 triplet He I lines was *T*eavg *=* 2.5 ± 0.3 eV.

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References

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