DETERMINATION OF ARGON PLASMA PARAMETERS AND THEIR SPATIAL DISTRIBUTION IN DC MAGNETRON DISCHARGE BY MEANS OF OPTICAL EMISSION SPECTROSCOPY AND COLLISIONAL-RADIATIVE MODEL

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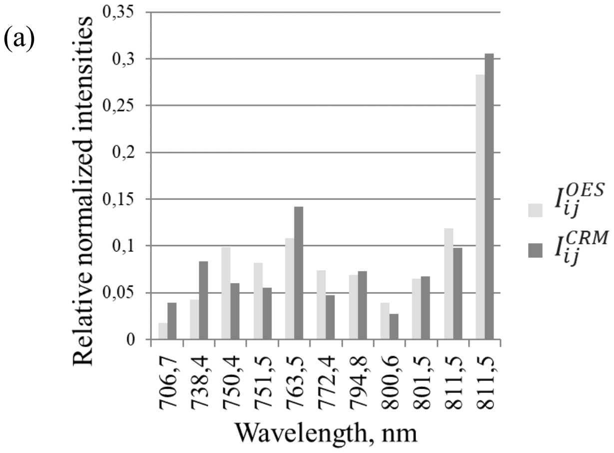
The work describes determination results of magnetron plasma parameters, such as electron density and temperature, and their spatial distribution in axisymmetric DC magnetron discharge with argon pressure in the vacuum chamber $P = 2$ Pa. A specialized experimental-computational technique was developed and applied to investigate local emissive characteristics of argon discharge plasma.

For experimental part of the study, a diagnostic complex based on the AvaSpec-2048 spectrophotometer was used, which allows to record optical emission spectra (OES) from various areas of the discharge due to two-coordinate movement of the optical collimator in the plane perpendicular to the magnetron axis [1]. The obtained chordal distributions of the Ar atoms spectral lines intensities were recalculated into radial distributions in various discharge cross sections using the inverse integral Abel transform mathematical apparatus.

The method of determining magnetron plasma parameters: electron temperature and density, is based on minimization of difference between relative intensities of Ar spectral lines obtained by optical emission spectroscopy experiment at various discharge areas and calculated theoretically by some model (see Fig. 1 (a)). To obtain calculated population densities of excited states, a collisional-radiative model (CRM) for Ar atoms is used [2]. Electron energy distribution function for this model was considered to be both Maxwellian and non-Maxwellian [3, 4].



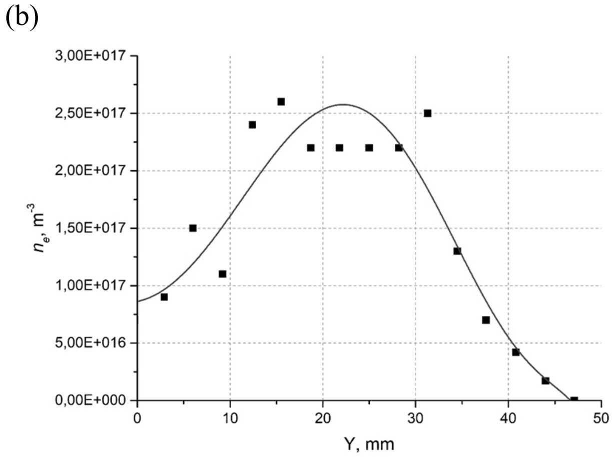


Fig.1 (a). Comparison between experimentally (OES) and theoretically (CRM) obtained Ar atoms spectral lines relative intensities, (b). Electron density radial distribution in axisymmetric magnetron discharge plasma with Ar pressure of 2 Pa.

The results obtained can be represented as radial distributions of plasma parameters. In particular, Fig. 2 (b) shows an example of the electron density distribution, which has a shape that correlates with the natural optical emission intensity distribution of an axisymmetric magnetron discharge with a dip near the axis and maxima in the region of the brightest glow.

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