Short talk

SHAPES OF SPECTRAL LINES OF NONUNIFORM PLASMA OF ELECTRIC ARC DISCHARGE BETWEEN COPPER ELECTRODES

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As well known, parameters of electric arc plasma which appear between contacts surfaces of switching devices depend from the electrode materials. The copper based composition materials (for example, Cu-W and Cu-Mo) are often used in the electrical engineering as electrode materials.

In our previous investigations of free burning in air electric arc between consumable electrodes we determined the electron density and the temperature in plasma by the optical spectroscopy. In a case of local thermodynamical equilibrium (LTE) the plasma composition can be calculated. So, obtained in such manner plasma parameters can be used for developing of the physical model of this multicomponent plasma source.

In this paper measurements were carried out in plasma of arc between Cu electrodes at current 3.5A and 30A. Discharge gap was l_{ak} = 2, 4, 6, 8 mm.

To determine the radial profile of electron density we investigated the shape of spectral line CuI 515.3 nm broadened by the dominating quadratic Stark effect. The Fabry-Perot interferometer (FPI) was used to study simultaneously the broadening of this line in the radial direction. We developed graphical program interface based on simulation which allows to provide the treatment of experimental obtained interferograms. By varying of the electron density and radial distribution of spectral line intensity it can be possible to reproduce the interferogram and to have in such manner these plasma parameters. We considered the case of axial symmetry of nonuniform plasma source distribution. To obtain the observed distribution of radiation intensity it must be integrated by full range of wavelengths which is selected by spectral device for preliminary monochromatization MDR-12. The transformation of radiation intensity by FPI is described as the function $J(\theta,\lambda)$, where θ is the angle of the incident radiation.

In addition the temperature radial profiles were calculated from relative intensities of several pairs of CuI spectral lines: 465.1, 510.5, 515.3, 521.8 and 578.2 nm, using spectroscopic data from different sources.

The electron density and the temperature in plasma as initial parameters were used in the calculation of the plasma composition in LTE assumption. We used the Saha's equation for copper, nitrogen and oxygen atoms, dissociation equation for nitrogen and oxygen atoms, the equation of plasma electrical neutrality and Dalton's law as well. So, it is possible to determine the amounts of metal vapors in plasma.