SPECTRAL PROPERTIES OF DC GLOW DISCHARGE SUSTAINED IN OXYGEN-ARGON MIXTURES

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Atomic oxygen can be employed as the active particle in miscellaneous applications. Plasma of DC glow discharge in oxygen and its mixtures is a medium where particles of atomic oxygen can be easily created from oxygen molecules by electron impact. Study of properties of such discharges is therefore very important topic.

Our experimental set-up consists of U-shaped discharge tube made from Pyrex glass (outer diameter 27.2 mm). Central part of the tube is equipped with head-on plane windows and also two pairs of cylindrical platinum probes (length 5 mm, diameter 0.1 mm) used for measurements of electric field strength. Spectra of emitted radiation were analyzed by means of monochromator Jobin Yvon-Spex Triax 550 using plane grating (1200 grooves/mm). The monochromator is equipped with CCD detector connected to the PC.

The discharge tube was heated up to 420 ºC and pumped for several hours before each measurement. The pressure in vacuum system checked after this procedure was about 5.10^{-5} Pa.

The measurements were realized in oxygen and argon of Linde production (declared purity better than 10 ppm) for Ar/O_2 ratio up to 99 % and for discharge currents up to 40 mA. The total pressure of the mixture was 400 Pa.

First we have focused on measurements of electric field strength with respect to the amount of Ar in the mixture. As can be seen in Fig. 1, the electric field strength remains practically unchanged for values of Ar/O_2 up to 10 % but decreases with further increasing of Ar/O_2 ratio. Moreover, decrease of electric field strength with discharge current was observed. Both facts are in a good agreement with our previous results [1].

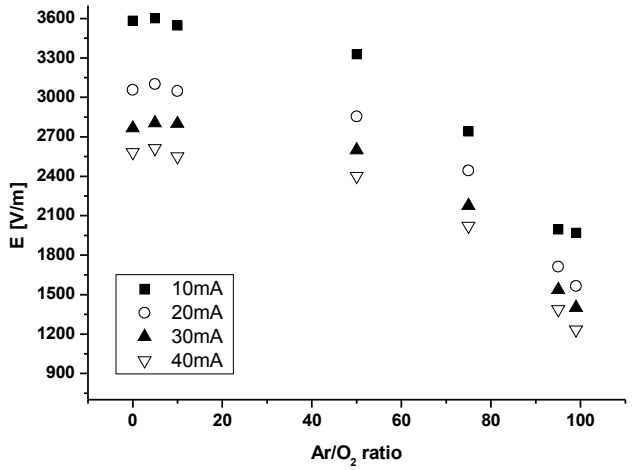

Fig. 1 Dependence of electric field strength on Ar/O_2 ratio for various discharge currents.

Our attention was paid to radiation emitted by oxygen atoms and molecules. Spectral lines of atomic triplet 777.6 nm and atomic oxygen 844.7 nm and atmospheric A-band of molecular oxygen with its head on 759.4 nm were detected in the emission spectra. Because of the great importance of atomic oxygen as the active particle, we have focused on intensities of both oxygen atomic lines 777.6 nm and 844.7 nm relative to the head of molecular A-band 759.4 nm.

Results are exhibited in Fig. 2. As can be seen from this figure, both intensity ratios $I_{777.6}/I_{759.4}$ and $I_{844.7}/I_{759.4}$ increase with Ar/O_2 ratio. That is probably due to dissociation of oxygen molecules by collisions with argon atoms. Moreover, both ratios increase also with increasing discharge current. This can be explained by more efficient dissociation by electron impact with increasing energy of electrons. It can also be seen that intensity of 844.7 nm line was systematically higher than intensity of 777.6 nm line.

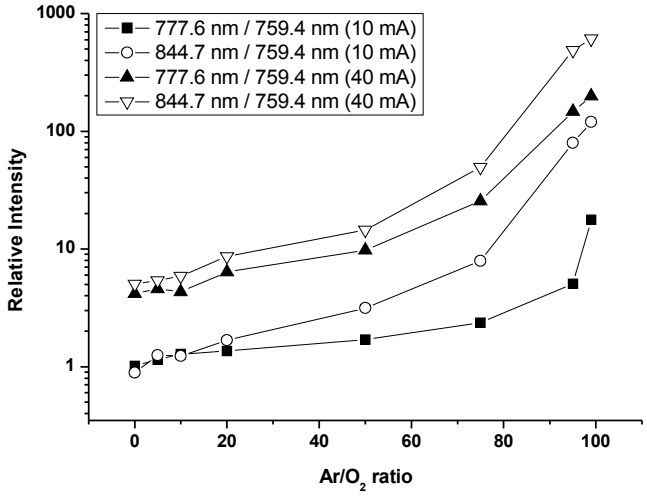

Fig. 2 Relative intensities of studied spectral lines

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References

[1] L. Schmiedt et al., Vacuum(2010), doi:10.1016/j.vacuum.2010.01.018