STUDIES OF PLASMA FORMED BY A DC DISCHARGE WITH A LIQUID CATHODE USING EMISSION SPECTROSCOPY TECHNIQUES

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In the past two decades, there has been a large increase in interest in research on the interaction of plasma with the surface of a liquid, mainly due, to the prospects for practical application. DC discharge with a liquid electrode is the simplest variant of the system in which the plasma interacts with the surface of the liquid [1]. Active particles in such a system are formed both in the plasma and in the surface layer of the liquid in contact with it [2]. In this case, the processes occurring in the liquid phase have a lot in common with the processes of radiation chemistry. The strongest radiation effects are observed when the liquid is a cathode; in this case, the surface of the liquid is bombarded by high-energy positive ions accelerated in the cathode layer, the magnitude of the voltage drop in which ranges from 400 to 800 V [1].

In this paper, we investigated the discharge of a direct current between a tungsten electrode with a diameter of 2 mm, which played the role of an anode and the surface of an aqueous solution, which played the role of a cathode. Tap water with an electrical conductivity of 300 µS/cm was used as an aqueous solution. The distance between the electrode and the surface of the solution was 2 mm, the discharge current was 100 mA. The discharge occurred in air at atmospheric pressure. AvaSpec 2048 three-channel fiber-optic spectrometer with a spectral resolution of 0.15 nm was used to record the emission spectra. The image of the discharge was formed by a short-focus quartz lens on a plane in which the inlet opening of the spectrometer light guide was displaced by means of micrometric screws. This made it possible to scan the image of the discharge with a positioning accuracy of no worse than 0.1 mm, which corresponded to the diameter of the inlet of the light guide.

In the emission spectra of the plasma, the emission bands of OH - radicals, molecular nitrogen N2, molecular ion N2+, and lines of atomic hydrogen H and oxygen O were observed. Three zones were measured: near the surface of the solution, in the central part of the discharge and near the electrode. It was found that all three zones have their own characteristics in the emission spectra. The OH - radical bands had approximately the same intensity in all three zones, the differences were no more than 30%. The intensity of the glow of the second positive system of molecular nitrogen N2 monotonously increased when moving from the surface of the solution to the electrode and reached a maximum near the electrode, the difference in emission intensity >3 times. The lines of atomic oxygen had a maximum intensity in the central zone of the discharge, while near the surface of the solution and near the electrode they fell, the differences in emission intensity ≈ 4 times. The line of atomic hydrogen had a sharp maximum intensity near the surface of the solution, the difference in emission intensity from the central zone of the discharge was ≈ 3 times.

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References

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