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A MODEL OF A LOW-PRESSURE DISCHARGE IN ACETYLENE *)

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The kinetics of hydrocarbon plasma is of interest both for fundamental research and for applied purposes. An important application of such plasma is the application of thin films based on hydrocarbon to various materials. Acetylene is often used as a feed gas, which is injected into the chamber, during the production of film. In the appendices, experiments were conducted to study acetylene plasma. In [1], the kinetics of hydrocarbon plasma of an RF discharge was investigated. The conditions correspond to low pressure (the researchers' experiment was conducted at a pressure of 30 mTorr). Experiments lead to the production of so-called diamond-like carbon (DLC). Calculations of the parameters of the glow discharge plasma in C2H2 at a pressure of 20 mTorr at a time interval of 1 s, implemented in the experiment, have been performed.

In our work, acetylene ionization is considered at a pressure of 20 mTorr and a current of 300 mA and a value of E/N =100 Td. A model consisting of 16 components has been developed: neutrals and radicals: C_2H_2, C_2H, C_4H_2, C_4H, C_6H_2, C_8H_2, C_2H_3, C_4H_3, H_2, H, C_6H_3; charged particles: electron and positive ions: C_2H^+, $C_4H_2^+$, $C_2H_2^+$, $C_6H_4^+$.

Calculations were carried out for two ionization models. In the first one, it was believed that effective ionization was taking place with experimental discharge characteristics. In the second, literature data on ionization cross sections were used and constants were calculated under experimental conditions. See Fig.1

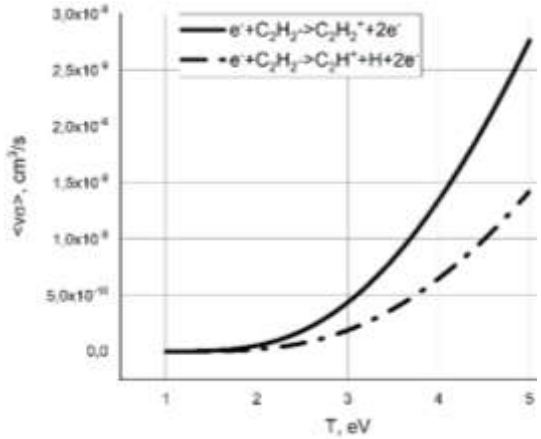

Fig.1. The values of the ionization rate constants as a function of the electron temperature in the acetylene discharge.

Under our conditions, the main radicals C_4H_3, C_6H_3 and C_2H, are obtained, they correspond to the radicals from [1] obtained under similar conditions. In the RF discharge [1], diamond-like films were formed under similar conditions. Therefore, it is possible to assume the appearance of diamond-like films in our conditions.

At low discharge power in the experiment [1] radicals C_4H_2, C_6H_2 are observed, which are absent in our model calculation, which may be due to the fact that in [1] a high-frequency discharge was used, at which additional low-energy ionization of acetylene occurs, leading to the formation of these radicals.

References

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*) abstracts of this report in Russian