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DIFFUSE VACUUM ARC DISCHARGE WITH HEATED CATHODE MADE OF MIXTURE OF CERAMIC AND METAL POWDERS*

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We present results of an experimental study of a plasma flow parameters generated by a vacuum arc discharge with heated cathode made of mixture of ceramic and metal powders. The discharge existed in a diffuse mode of cathode current attachment [1]. The diffuse mode was characterized by relatively low values of cathode current density (10-100 A/cm^2), absence of significant voltage oscillations and stable glow of plasma formation (Fig. 1).

The experiments were carried out in vacuum chamber with residual gas pressure less than 10 mPa. The cathode was presented by a mixture of powders of cerium dioxide (CeO_2) and chromium (Cr). The cathode mixture was placed in a molybdenum crucible, under which an electron beam heater (EBH) was situated. The mixture was tentatively sintered in vacuum at a temperature of the crucible of 1500 C for an hour. At a temperature of 1900 C the breakdown of the discharge gap was initiated. The molybdenum plate with centered hole of 14 mm in diameter for plasma outflow was used as an anode of the arc. The length of the discharge gap was about 30 mm. EBH allowed us to vary the crucible temperature at fixed arc current that caused significant changes of the discharge parameters, in particular, a voltage drop of the discharge gap.

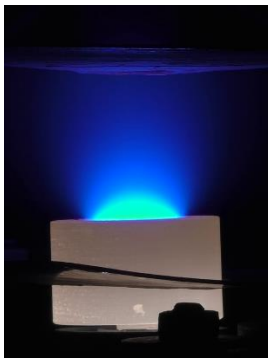

Fig.1. Photo of the diffuse vacuum arc discharge on mixture cathode of CeO_2 and Cr powders.

The dependencies of heat fluxes coming from plasma into the cathode on arc current and power of EBH were studied. The data on mean charge of the arc plasma flow, ion energies and ion composition obtained by time-of-flight mass spectroscopy method [2] were obtained. It was shown that chromium is a main source of the plasma forming medium when cerium dioxide is a main source of electrons of thermionic emission. The comparison of the arc discharge parameters on mixture cathode with arcs on monocomponent cathodes of Cr [3] and CeO_2 [4] was performed.

Obtained results can be useful in designing of stabile plasma sources of multicomponent condensed substances for wide range of applications from deposition of composite coatings to plasma mass separation [5].

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