

MODELLING CURRENT TRANSFER TO ARC CATHODES COVERED BY MONOLAYERS OF ALKALI METALS*

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Under conditions characteristic of metal halide (MH) lamps, work function of the cathode surface is affected by formation on the surface of monolayers of alkali metals. Effect produced by such variations of the work function on the current transfer is studied in this work.

An account of variation of the work function is implemented as a part of the general code¹ describing interaction of high-pressure plasmas with thermionic cathodes. Main features of current transfer to cathodes covered by monolayers of alkali metals are studied by means of numerical simulation with the use of the code developed. The modelling is performed for particular cases where the plasma-producing gas contains mercury and sodium or cesium while the cathode is made of tungsten.

It was found that even small amounts of the alkali vapor in the plasma, of the order of 1% and less, can produce a significant decrease of the work function. The decrease of the work function produced by adding Cs to the mercury plasma is stronger than that produced by adding Na and comes into play at higher values of the surface temperature.

Results of two-dimensional simulations of the diffuse discharge on tungsten cathodes are given. In the case of the Na-Hg plasma, formation of the sodium monolayer affects the diffuse mode of current transfer in the same direction that the presence of metal atoms in the gas phase does, i.e., the cathode surface temperature and the near-cathode voltage drop decrease while the range of stability of the diffuse mode expands. In general, formation of the sodium monolayer affects the plasma-cathode interaction only moderately.

On the contrary, formation of the cesium monolayer changes the plasma-cathode interaction dramatically: the temperature of the cathode surface decreases very strongly, the current-voltage characteristic of the diffuse mode of current transfer becomes N-S-shaped. Note that the S-shape is a result of non-monotonic dependence of emission current on the surface temperature, which, in turn, results from the increase of the work function with the surface temperature.

1. M. S. Benilov and M. D. Cunha, "Heating of refractory cathodes by high-pressure arc plasmas: I", *J. Phys. D: Appl. Phys.* **35**, pp. 1736–1750 (2002).

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