INVESTIGATION OF THE Temporal EVOLUTION OF A VACUUM ARC WITH A HEATED CATHODE MADE OF CERIUM DIOXIDE [[1]](#footnote-1)\*)

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The development of plasma sources of dielectric materials is relevant for the creating functional coatings [1] and plasma separation methods [2]. Plasma sources based on vacuum arcs provide high performance, while the parameters of the generated plasma flow depend on the type of cathode attachment being implemented under specific experimental conditions [3]. A vacuum arc on a cathode made of cerium dioxide was described in [2]. Cerium dioxide is used for creation corrosion-resistant coatings and ultraviolet emission protection films [4-5]. This work is devoted to the study of the temporal evolution of discharge parameters.

The experimental setup [2] was a vacuum chamber with a volume of ~ 1 m3, the pressure of residual gases was about 10-5 Pa. The cathode was a CeO2 weighing about 5 g placed in a molybdenum crucible. The crucible was heated using 1.5 kW an electron beam heating. The temperature of the side surface of the crucible was controlled by an optical pyrometer. To establish the ionic composition, a time-of-flight mass spectrometer with a resolution of 25 was applied, located behind the anode at a distance of 300 mm. During the experiment, the voltage, mass-spectrum of plasma ions, cathode temperature and radiation intensity were continuously recorded. During the experiments, the discharge current was fixed - 65 A, and the voltage and crucible temperature ranging from 10 to 14 V and from 2.15-2.35 kK respectively.

Fluctuations of arc voltage, amplitudes of mass peaks and spectral lines intensity were detected during research. The relative values of fluctuations vary over time in the range from 2 % to 10 % for voltage and from 10 % to 30 % for the amplitudes of mass peaks. The average value of the voltage at fixed arc current and the crucible temperature was decreasing during the experiment by up to 1.5 V. Unstable regimes were observed, remaining from several seconds to several minutes. The amplitude of fluctuations was increasing, ions of higher multiplicities were observing and oscillations of the plasma column were recording within such regimes. The video recording of the cathode surface revealed that during the experiments both vacuum arc modes without cathode spots and with type 2 spots occurred [6]. The transitions between modes also occurred in case of the varying of crucible temperature. After a time of about 1000 s after initiation, the discharge became less stable. The study of the ionic composition revealed that single cerium ions Ce+ and molecular ions CeO+ predominate in the plasma flow, and molybdenum ions Mo+ are also present. The ionic composition of the plasma changes over experiment time, even within stable discharge regime: the content of crucible material ions in the plasma flow changes, while the intensities of the Ce+ and CeO+ peaks are approximately constant.

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1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLIX/Lt/ru/EU-Melnikov.docx) [↑](#footnote-ref-1)