HIGH-CURRENT PULSED PLANAR MAGNETRON DISCHARGE WITH ELECTRON INJECTION [[1]](#footnote-1)\*)

DOI: 10.34854/ICPAF.2023.50.2023.1.1.186

1Shandrikov M.V., 1,2Oks E.M., 1Cherkasov A.A.

1Institute of High-Current Electronics SB RAS, Tomsk, Russia, shandrikov@opee.hcei.tsc.ru,  
2Tomsk State University of Control Systems and Radioelectronics, Tomsk, Russia

The results of experimental studies of a discharge system based on a planar magnetron discharge with additional electron injection are presented. The essential difference between the proposed method and known systems with electron assistance is that the injection of electrons into the magnetron discharge is carried out from the back of the sputtered target through the central aperture. This approach provides additional acceleration of injected electrons in the cathode layer of the magnetron discharge and an increase in the energy efficiency of the discharge system. The plasma of a glow discharge with a hollow cathode and a vacuum arc discharge was used as an electron emitter. The magnetron discharge operated in a high-current (5÷50 A) pulsed (200÷400 µs, 5÷25 Hz) mode. The diameters of the copper target and the central emission aperture were 125 and 2 mm, respectively. Argon was used as a working gas. The mass-charge composition of the ions was determined using quadrupole and time-of-flight spectrometers.

It is shown that the use of additional injection of electrons into the cathode layer of a magnetron discharge makes it possible to reduce the lower limit operating pressure of a magnetron discharge by 2-3 times while maintaining the amplitude of the discharge current at a given level. At the same time, the combined use of a central electron injection and a conical reflecting electrode located behind the outlet in the target in the path of the injected electrons allows maintaining a high value of the ion fraction of the target material, including in the range of low operating pressure values. In this range a standard magnetron discharge is characterized by an increase in the ion fraction of the working gas, or is not realized in a high-current mode. The optimal shape, size and spatial location of the reflecting electrode are investigated to achieve the greatest effect on the parameters of the magnetron discharge. The main changes in the microstructure of films formed at the operating pressure decreases during magnetron deposition are demonstrated.

This work was supported by the Russian Science Foundation, project # 21-19-00136.

1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/L/Pt/ru/GH-Shandrikov.docx) [↑](#footnote-ref-1)