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The features of the breakdown and discharge formation in HIPIMS with various target materials

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Currently, increased attention is paid to the high power impulse magnetron sputtering (HIPIMS) in the field of physical vapor deposition (PVD) attribute to the high ionization rate of sputtered vapors. The main feature of this technique is the high density plasma in vacuum chambers. The increased interest in the study of HIPIMS discharge is due to the presence of a number of unresolved fundamental problems. Among them are the processes of the breakdown and discharge formation, refinement the mechanism of generation of multicharged ions, electron anomalous transport, low deposition rate, as well as opportunities of wide practical application for metal-ion generator and the deposition of coatings. The objective of this work is to study particle ionization processes for the breakdown and discharge formation with the pulse voltage of 400-1000 V during the HIPIMS discharge.
Investigation of breakdown and discharge formation was carried out by means of oscilloscope and optical emission spectroscope (OES). The discharge chamber with a rectangular unbalanced planar magnetron was filled with pure argon. The time evolution of target currents was investigated with different targets and pulse voltages in HIPIMS discharge. The target current waveforms varied with different target materials. And for the same target material, they were distinct at different pulse voltages. The corresponding ionized and excited-state concentrations were analyzed on the basis of the OES spectra. The OES measurement permitted to obtain more accurate information about the time evolution of radiation intensity from different target materials. The results showed that the breakdown was developed in the form of the ionization wave propagating from the potential electrode with the highest concentration of electric field to the grounded one. The sharp increase of the target current and radiation intensity indicated to the possibility of changing the discharge mechanism.

Keywords
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