ELECTRICAL CHARACTERISTICS OF A HOT-TARGET HIPIMS DISCHARGE IN REACTIVE O_2/AR AND N_2/AR ENVIRONMENTS*

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A high-current pulsed magnetron discharge in a reactive (oxygen- or nitrogen-containing) medium with a thermally insulated target is a promising and currently little-studied type of gas discharge, which can be used to obtain high-quality oxide and nitride coatings at rates significantly higher than those in classical magnetron sputtering systems. To adequately describe the entire variety of processes occurring on a target in this regime, the numerical model of the thermal state of the target [1] and the nonstationary model of reactive film deposition in pulsed sputtering systems with a high discharge current density (more than 10 A/cm^2) can be considered [2]. For the development of these models, it is necessary to experimentally study a high-current pulsed reactive magnetron discharge with target evaporation and to determine the dependences of its parameters on the flow of the reactive gas into the vacuum chamber.

In this work, we study the effects introduced by adding a reaction gas (O_2 and N_2) to a magnetron discharge with a thermally insulated target from the point of view of its electrical parameters. The dependences of the current-voltage characteristics and the shapes of the current and voltage pulses of a high-current pulsed magnetron discharge on the reaction gas flow are studied.

To form the discharge, an APEL-M-5HPP-1200 power supply with a maximum average power of 5 kW was used. We analyzed the voltage and current waveforms recorded at various pulse duration of 50–500 µs, frequency of 1 kHz and for reactive gas flow rates 0–1.80 l/h. The voltage and current waveforms exhibit a transition into unstable mode with increasing the reactive gas flow and pulse duration. In this mode, in power-regulation regime of the power supply, the pulses follow certain recurring patterns characterized by the current oscillations in a wide range from several to tens of amps.

REFERENCES

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