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PLASMA INSTABILITY IN A LASER CONTROLLED HIGH-VOLTAGE SWITCH FOR RADAN TYPE ELECTRON ACCELERATOR *

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The laser-induced gas breakdown [1] is widely used in high-pressure gas gaps with optical control [2, 3]. The stability of switch transition time to the conducting state is important both for commutation losses decrease and when it is necessary to fire up several devices simultaneously on a conjoint load. The most significant advantage of optical controlled switches in comparison with electrically triggered analogs is the isolation of control circuits from commutated ones. Despite decades of development, this determines the interest in the improvement of such switches even in the present time and the activity aimed at their development is underway now, in particular, new switches has been patented quite recently [4]. Thus the data we obtained earlier [5] could not be explained in frameworks on simple theoretical models [6]. Using this approach no one can explain the both the dependence of the delay time t_d vs gap voltage U (Figure 1) and its instability (jitter), since the initial laser plasma formation is not related to the voltage, i.e. the field strength in the spark gap, because it is determined by the laser pulse characteristics. Our analysis of the distribution of the axial electric field of the gap for different sizes of a laser plasma plume shows its dynamics is similar to that one of the ionization wave front in a cathode propagating streamer as a result of the transfer of resonance radiation along with associative ionization [7]. The processes on the ionization wave front seem to be determined mainly both by the absorption/excitation of gas atoms and the effects of a high-field domain (HDV) we propose.

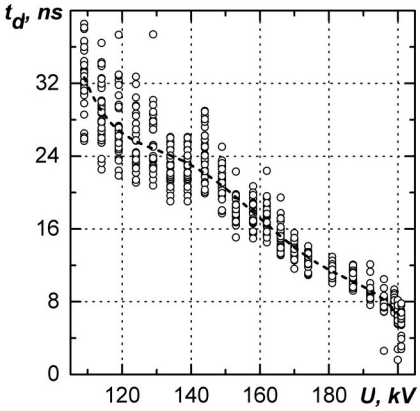

Fig.1. Switch on delay time vs gas gap voltage.

Within the framework of the model we developed the formation of HDF is studied both with and without accounting the effect of electron photoemission from the anode induced by laser radiation. It has been established the role of this electron photoemission plays a minor role in the formation of such HFD. Nevertheless, it has been found that this factor mainly affects the stability of the switching characteristics for devices of this type.

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