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Research on the Working Gas Pressure of Spark Gap Switch in High Power Laser System

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Laser inertial confinement fusion will be a kind of new energy supply in the future. As a drive source of inertial confinement fusion, the large laser equipment is used to afford the high power laser beam for thermonuclear fusion. A high-current closing switch is an important component in pulsed power systems. High-energy switch and its trigger system are required for the discharge applications of capacitor bank, such as electro-magnetic rail, coil, and electro-thermal guns. In a high–energy laser system, a two-electrode spark-gap switch is used as the main one in this paper. The static breakdown voltage of switch is determined by the working gas pressure. Graphite electrodes will erode during the discharge operation of the system and the erosion of electrodes results in an increase in the gap width, causing the DC breakdown voltage to rise. In the fixed triggering mode, it is essential to make sure that the under-voltage rate is relatively stable when changing the switch's gas pressure. When the under-voltage rate of switch is low, the rate of stable triggering and self-breakdown will decline. In this paper, the relationship between the breakdown characteristics and the working gas pressure of a spark gap is studied. A comparison was made from the DC breakdown voltages of various switches under different gas pressures and the triggering reliabilities were tested. It is shown that a controlled reduction in pressure can compensate for the gap widening effect and thus ensure switch operation even with electrode erosion. By determining the under-voltage rate which ensures switch conductions, a gas pressure regulation method was devised to ensure the stable operation.

Primary author: ZENG, Han (East China Jiaotong University)

Co-authors: Dr ZOU, Dandan (East China Jiaotong University); Ms WU, Hua (Maintenance branch of Jiangxi electric power company); Mr LIU, Wei (Jiangxi Electric Power Design Institution); Mr ZHANG, Xiaobo (Shanghai Qiyi electronics technology Co.,Ltd)

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