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Generation of anode plasma and its effects on diode characteristics

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Generally, the performances of high power electron beam diode, such as current levels, impedance collapse, and plasma expansion, have been attributed to the combination of the cathode and anode instead of just the cathode. The issues of anode have been paid more and more attention in research and practical applications. In this paper, five kinds of anode materials, stainless steel, titanium (Ti), molybdenum (Mo), graphite, and graphite modified by titanium carbide (TiC/Graphite), were investigated to figure out the influence of anode material on the characteristics of the diode. The results, both of experiments and theoretical analyses, point out that anode plasma plays a vital part in the characteristics of the diode. The changes of diode voltage and current waveforms were analyzed by the impedance data. It was found that the diode voltage and current follow different space-charge limited flow models when different anode materials were used. The anode and cathode plasma expansion velocities were calculated based on three cases, without anode plasma in the duration of a pulse, with anode plasma in the later stage of a pulse, and with anode plasma at the earlier stage of a pulse, which were classified by occurrence time of anode plasma. This analysis was supported and proved by the results of diode plasma photographs. The causes of anode plasma were inferred from the changes of anode materials after several pulses, which were also in conformity with the classification of the three mentioned cases. This study reveals that the diode performances are easily affected by anode plasma when Ti, Mo, and stainless steel are used as anode materials, respectively. Considering the drawbacks of porous and carbon contamination of pure graphite material, however, TiC/Graphite may be better choice for anode material at the similar conditions.

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