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Effects of the series impedance on vacuum arc plasma onset

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The surface electric field has been regarded as the only parameter that determines the occurrence of a vacuum breakdown (VBD) for a given surface condition. However, recent studies have accumulated an increasing amount of evidence indicating that the ultimate limit depends strongly also on the electromagnetic power that is available to be delivered at the VBD site. Here we study this dependence both experimentally using a pulsed DC system and by numerical plasma simulations using the particle-in-cell (PIC) model ArcPIC [Timko et. al. Contrib. Plasma Phys. 55, 299(2015)]. By varying the series impedance, we controllably limit the power coupling from the source to the vacuum discharge gap. The experimental results show that the breakdown voltage increases with increasing impedance, i.e., with increasing circuit resistance and decreasing capacitance. The ArcPIC results showed that a minimum current is required to ignite the plasma, and the breakdown voltage is defined by the circuit impedance and the critical power loaded to the gap just before the breakdown.

Topic

Modeling and Simulations

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