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Spectroscopic and Microscopic Observations of Anode Behaviors in Vacuum Breakdown

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Under sufficient high electric field, a breakdown process will be triggered in a vacuum insulation system, influencing the efficiency, reliability and even safety of the system. The transition to a vacuum arc, which is indicated by the formation of a conductive channel in the initial vacuum gap, is an important process for a deeper understanding of the vacuum breakdown. According to our previous work, the anodic glow has no dominant contribution to the conductive path formation, and it is only a secondary effect of the cathode events. In this paper, we investigated the anodic glow in more detail, in order to reveal some nature of the cathode events and the conductive channel formation from this related secondary phenomenon. Spectroscopic and microscopic observations were conducted for a tip-cathode-plane-anode system. Based on the analyses of the result, both the cathode and the anode provide atoms for the anodic glow region in every shot of breakdown. The atoms from the burning cathode spot can reach the anodic glow region at the very beginning of the appearance of the anodic glow, and there should be some concentration process for these cathode atoms at the anode surface, which makes the light intensity in the vicinity of the anode higher than that in the middle of the gap. The material transfer from the cathode to the anode during the entire breakdown can form a contamination layer on the anode surface, which provides atoms to the anodic glow in the following breakdowns. The contamination layer on the anode surface has a “covering effect”on the bulk of the anode. The former usually contributes more atoms to the anodic glow than the bulk of the anode, and sometimes even blocks the atom supply from the bulk of the anode.

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