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Influence of Cathode Melted Layer on Vacuum Insulation

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The objective of this paper is to determine influence of depth of cathode melted layer on vacuum insulation. A 12kV vacuum interrupter with a pair of rod-plane electrode was designed. A DC current source is applied on the test vacuum interrupter, in which the rod electrode is chosen as anode. A drawn vacuum arc is used to generate different depth of melted layer on the rod electrode in an anode spot arc mode. The arcing time can be controlled as 0ms, 10ms, 46ms and 73ms, respectively. Then the vacuum gap was adjusted at 1mm to measure the basic lightning impulse breakdown voltage. Positive polarity standard 1.2/50μs lightning impulse voltage was applied by a basic up-down method, in which the rod electrode was the cathode. Experimental results revealed that the breakdown probability distribution followed a Weibull distribution when the breakdown voltage reached saturation. The 50% breakdown voltage of different arcing time 0, 10, 46 and 73ms corresponded to 55.6, 73.3, 75.5 and 77.9kV, respectively. After that, rod electrode surface and cross section of the rod electrode were analyzed by electron microscope and the average depths of melted layer were 0, 5, 35 and 65um, corresponding to current arcing time 0, 10, 46 and 73ms, respectively. The depth of melted layer was approximately linear to the arcing time. The of vacuum gap with the melted layers increased significantly than that without melted layer. The of vacuum gap with different depth of melted layer were very close each other. Thus, the melted layer did improve the breakdown voltage but the depth of melted layer has no significant influence on the breakdown voltage.

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