

Investigation on local field enhancement of a typical three electrode system in DC conductivity measurement

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In the evaluation of insulating materials, the design and choice of the electrode system in which the insulating material is to be measured would play a crucial role. There are various electrode systems provided by the current IEC and ASTM standard. In this paper, influence from the shape of a circular metallic electrode with guard ring, which is very common in DC conductivity measurement for its simple structure, is investigated. Mineral oil with different aging times are tested using this electrode system.

According to IEC and ASTM standard, there are four parameters of this electrode system that can affect the DC conductivity measurement, distance between two electrodes, distance between guard and guarded electrode, outer radius of the guard ring and the outer radius of the guarded electrode. Here, we are going to add a new parameter, the edge radius to the system, which is not mentioned in current standards but is quite important in liquid dielectrics measurement. The experimental result shows that increase the edge radius can lead to a higher applied voltage in DC conductivity measurement.

The distribution of electric strength of this electrode system is simulated by Comsol Multiphysics. As seen from the simulating result, there would be a point that has much higher electric strength near the edge of the guard and guarded electrode. If the edges of these two electrodes are very sharp, the maximum electric strength in the test cell will increase. A recommendation has been made to current standard in liquid measurement. Besides, since there is a new parameter in this system, the conductivity calculated from the electric strength in the gap is compared with the value obtained from the equation of international standards.