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Study on Impulse Breakdown Characteristics in Transformer Oil with Different Electrode Materials

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The bubble mechanism based on field emission has long been considered to be responsible for breakdown in liquid under impulses with duration of microseconds. Hence, it is quite reasonable to associate the breakdown voltage with the metal electrode materials.

In this paper, we took 25# transformer oil as the liquid insulating dielectric, which had been degassed and dried for 12 hours in advance. The hemispherical electrodes were made of aluminum, stainless steel, copper and copper-tungsten, respectively. The 0.12/50μs non-standard lightening impulse was utilized and the interval between each breakdown was 5min.

The 50% breakdown voltages and the discharge time delay with different electrode materials were acquired through experiments, along with the corresponding three-parameter Weibull distribution functions and the Laue plots. It turns out that the average breakdown field strength are quite different and the copper-tungsten is the highest, followed by stainless steel, copper and aluminum. Meanwhile, the shape parameters of the three-parameter time-dependent Weibull distribution functions were all around 1, making Laue plots available. Thus, the average statistical time lag and the average discharge formation time were derived from the Laue plots and the differences were discussed. What'more, the existence of the turning point in Laue plot proved the combination of two parallel initiation processes. The surface roughness and the work function were both taken into consideration to analyze the experimental results.

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