Chapter 2
Flashover and Surface Charge in GIL Insulator

ABSTRACT

Many works have been studies in order to improve flashover voltage in GIL insulator. Under DC, the insulator electric field is decided by the conductivity and surface charge distribution. This chapter takes cone-type insulator as research object and then finds the characteristics of flashover, surface charge accumulation, and the interface electric field regulation (IER) of epoxy (EP)-/graphene (GR)-coated insulator. Theoretical analysis demonstrates that the uniform surface charge of monopole is conducive by reduce peak field and flashover voltage. Among them, that of 0.1% EP/GR possesses the highest flashover voltage. With the SiC content and coating thickness enhancement of IER insulator, the electric field regulation of EP/SiC-coated insulator becomes notable, due to energy loss and increasing leakage current. The results show that insulator coated by EP/SiC can reach higher flashover voltage than uncoated insulator and enhanced SiC content contributes to improve the flashover voltage.

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INTRODUCTION

GAS insulated lines (GILs) is considered as an ideal solution to respond to the challenge of high reliability, large capacity, compact size and environmentally friendly (Winter, 2012). Epoxy with alumina (EP/Al_2O_3) insulators are used to support conductors and provide electrical insulation, which becomes one of the key components of GILs. With the development of UHV technology and the reliability of transmission, GIL insulators must be produced in large quantities (Wang, 2017). Under operating conditions, the flashover of the GIL insulator occurs randomly (Li, 2017). In order to reduce the size of GIL insulation and improve its reliability, much research has been done on improving the flashover voltage of insulators. A new type of electrical insulating material technology can bring higher performance and reliability to power equipment and system. For example, SF6 gas insulated power equipment, such as GIS, has greatly reduced the scale and floor area of power equipment and substations. However, due to the high sensitivity of SF6 gas to the electric field, the insulation design and configuration of gas insulated power equipment become complex, and the cost of control, relaxation and optimization of the electric field is also increasing. Therefore, a new and innovative technology of electrical insulation material is one of the important tasks of future power engineering.

The main reason of flashover is caused by non-uniform field along the surface of the insulator. Therefore, changing the introduction of shielding electrodes, the optimal designs of insulator shape and embedded electrodes are introduced to solve this problem. However, these methods have greatly increased costs. Therefore, it is necessary to propose some feasible methods to solve the flashover problem of GIL insulators.

Under the action of AC and DC voltage stress, the electric field distribution along the insulator is obviously different. For a given electrode arrangement including an insulator, the electric field under AC voltage depends on the dielectric constant of the dielectric involved, thus generating a so-called capacitance field distribution. Under DC voltage, the steady-state electric field distribution, the so-called resistance field distribution, is mainly determined by the volume and surface conductivity of insulating materials. The distribution of static resistance field along the insulator is related to the accumulation of charge carriers on the dielectric interface, which may lead to the decrease of flashover voltage, especially when the polarity of applied voltage is

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