Effect of Annealing Temperature of the Functional Nano Thin Films Synthesized on a Ceramic Substrate

Won Seok Choi¹, Kiwon Lee², Young Park², Yeun-Ho Joung¹, Seok Hun Kwon¹, Jung Hyun Kim³, and Hyunil Kang¹,∗

¹College of Information Technology, Hanbat National University, Daejeon 34158, Republic of Korea
²High-Speed Railroad System Research Center, Korea Railroad Research Institute, Uiwang 16105, Republic of Korea
³Department of Applied Materials Science and Engineering, Hanbat National University, Daejeon 34158, Republic of Korea

The insulation resistance of a ceramic insulator substrate decreases when contaminants are attached to its surface, and this can result in a spark flashover that can trigger accidents involving power transmission or power supply systems. To prevent such accidents, ceramic insulators have to be continually maintained and cleaned regularly. However, removing contaminants attached to ceramic insulators requires the use of much water and entails a high cost. Thus, the maximum washing efficacy with a minimum amount of water should be secured. The surface features of the object that will be washed are an important determinant of the washing capacity. In this study, ceramic insulators are coated with a nano-sized functional thin film by using the spray coating method. The coated ceramic insulators were annealed with an increase in temperature from 100 °C to 400 °C. Then, the surface features of the annealed ceramic insulators were analyzed, and the results of the experiment are presented.

Keywords: Functional Nano Thin Films, Ceramic Insulator, Spray Coating, Surface Feature.

1. INTRODUCTION
Ceramic insulators are commonly used to insulate the exterior of power transmission, distribution, and power supply equipment, and they are compatible with electrical wires. Ceramic insulators must thus have a high electrical insulation and mechanical strength, and they are mainly used due to their high insulation performance and durability. A ceramic insulator is exposed to the external environment, so the likelihood of an insulator failure is high. Accidents resulting from contamination occur mostly in the early morning or late at night, and most instances of accidents involving ceramic insulators are flashovers. Contaminants may influence a flashover when they are attached to the insulator surface. The contaminants are attached to the insulator surface. As moisture increases due to fog and dew, contaminants then result in an increase in leakage current and a decrease in insulation performance. In such cases, a flashover can be the cause of a major accident.

Industrial pollution and marine pollution are the types of contaminants that settle on the surface of a ceramic insulator. Industrial pollution consists of dust, smoke, cement, and so on. Dust and smoke are produced by vehicles, buildings and plants, and cement is ejected from cement plants, construction sites and rock quarries. These particles then attach to the surface of the ceramic insulator mainly by wind. Marine pollution is mainly caused in coastal areas where ceramic insulators are exposed to coastal environments. Ceramic insulators exhibit conductive behavior when a conductive layer forms on the insulator surface. The conductive layer forms due to the presence of salted dew in the mornings in coastal areas. Therefore, a ceramic insulator must be periodically managed to prevent ceramic insulator accidents. In addition, regional characteristics should also be considered when removing contaminants. The surface features of the ceramic insulator should be considered to determine the proper removal methods, and wet and dry cleaning methods can be applied to ceramic insulators. A wet cleaning method is generally used in coastal areas where ceramic insulators are highly exposed to damage by salt, and in these cases, the ceramic insulators are cleaned by spraying detergents. Also, ceramic insulator cleaning robots for livewire applications operate using the