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HIGH-FIELD EXCITED FLASHOVER ACROSS SOLID DIELECTRICS IN VACUUM: MECHANISM AND SUPPRESSION

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Surface flashover in vacuum is a great limitation of electrical and electronic system, since it typically takes place on the surface region of an insulating material at applied electric stress much lower than the bulk breakdown strength of the material. This paper gives a review of surface flashover phenomena of insulators, especially its mechanism and techniques to improve withstanding voltage. We propose that flashover is a kind of complicated surface and interface physical phenomena. Based on the concurrent optical and electrical measurements and microscopic observations, the research works of our group concentrate on the relationship between flashover and surface/interface condition of insulating materials. The experimental results reveal that, under low electric field, prior to field electron emission from the cathode triple junction, electroluminescence phenomena occur due to the radiative recombination of electrons and holes injected into the surface states from the electrodes. We attribute the preflashover phenomena to the differences between the surfaces of solid dielectric materials. According to the results, the phenomena mentioned above are cloaely related to the trapping parameters in the surface layer of a material. This work is a contribution to the traditional secondary electron emission avalanche (SEEA) model. For improving the hold-off voltage of insulators, several suggestions are given regarding how to select the material, geometry and surface processing when designing an insulator-vacuum system. Some useful techniques are presented and discussed, e.g., reducing the shallow traps of insulator greatly improve its flashover stability and decrease its flashover scattering.

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