Modeling of corona partial discharge under various electrode types with Finite Element Analysis

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Introduction: Partial discharge (PD) is the most unwanted phenomenon in high voltage insulation system. It causes degradation to the equipment insulation leading eventually to the breakdown and system failure. One type of PD, called corona discharge, occurs due to the ionization of the air between high voltage electrode and the ground or at any sharp point under high voltage stress. In this work, the electric field (EF) distribution was simulated using finite element analysis (FEA) to study the influence of EF on corona discharges due to different electrode geometries.

Computational Methods: In this study, COMSOL Multiphysics software was used to model the corona PD under different electrode geometries (sharp, flat and sphere). Two dimensional (2D) axial symmetric model have been built to study the electric filed distribution and its influence on corona PD occurring. Figure 1 shows sphere electrode model as example for others two electrodes (sharp and flat). 'Electric current physics' was used to study the electric field distribution between high voltage electrode and the ground. In order to obtain more accurate result, an extremely fine element size was used in physics controlled mesh. Time dependent study was used to solve the model to calculate the electric field distribution.

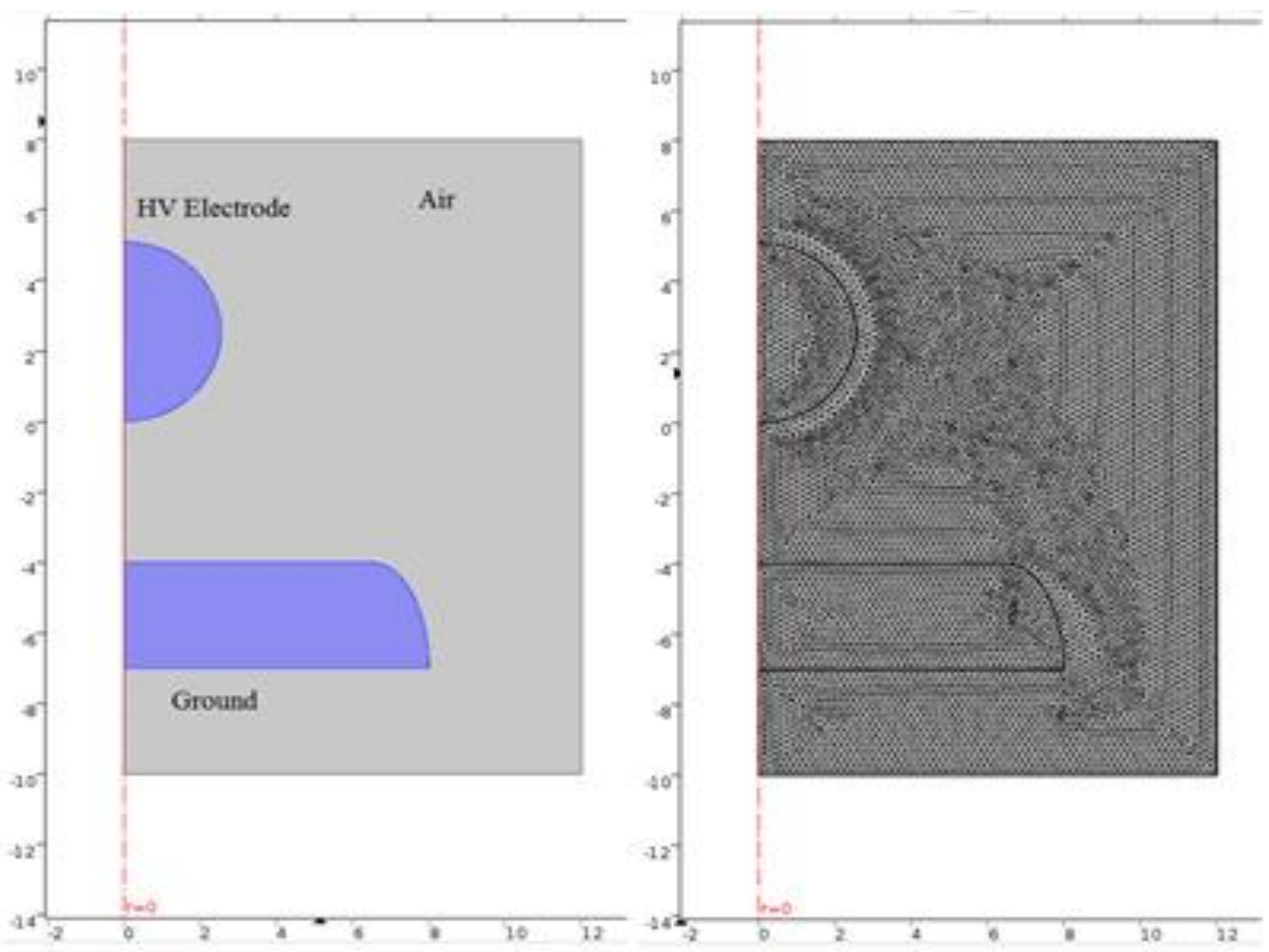

Figure 1. Sphere electrode model

Results:

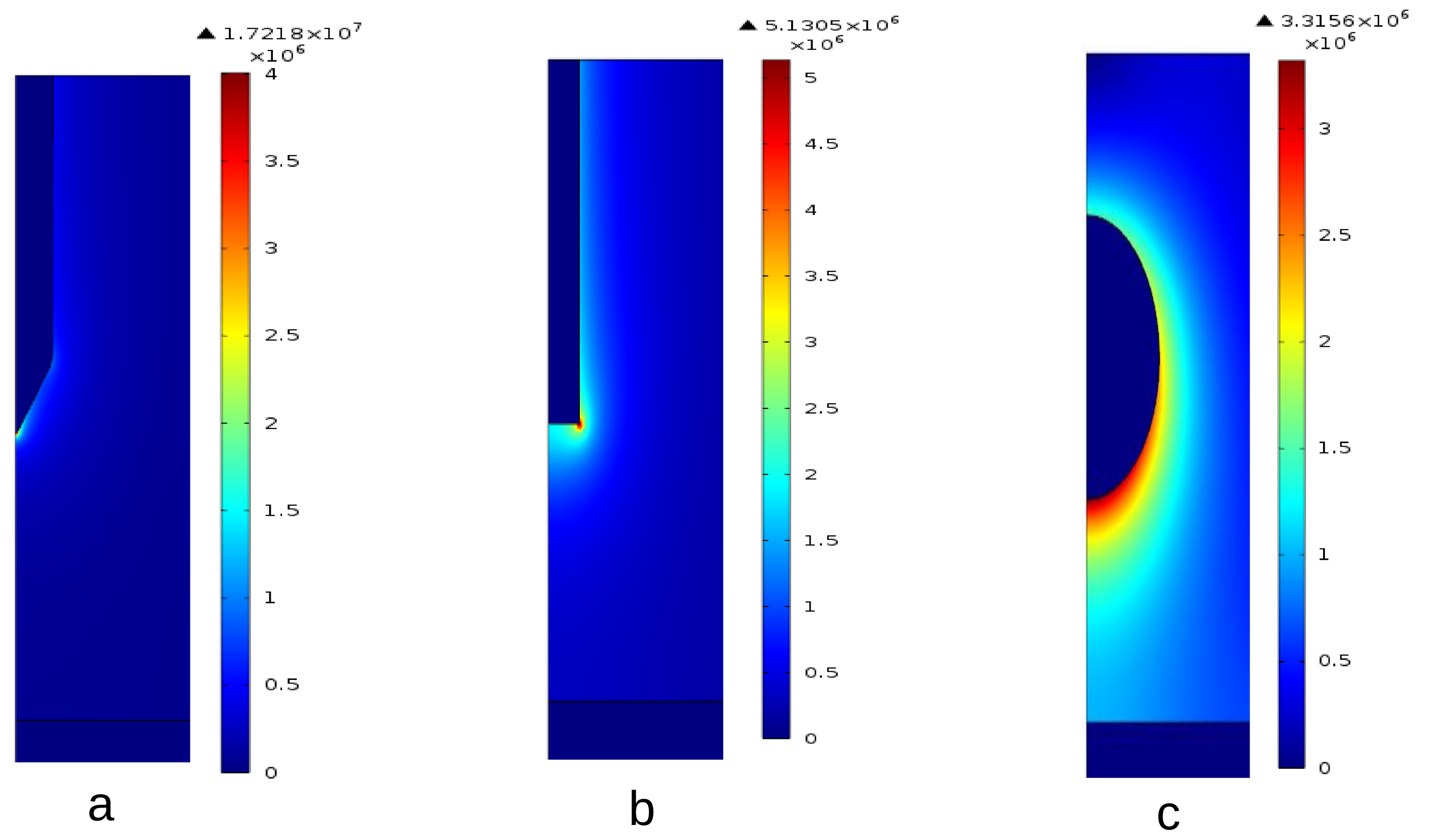

Figure 2. Simulation of electric field distribution from different electrode; (a) sharp, (b) flat and (c) sphere electrodes under 20 kV applied voltage

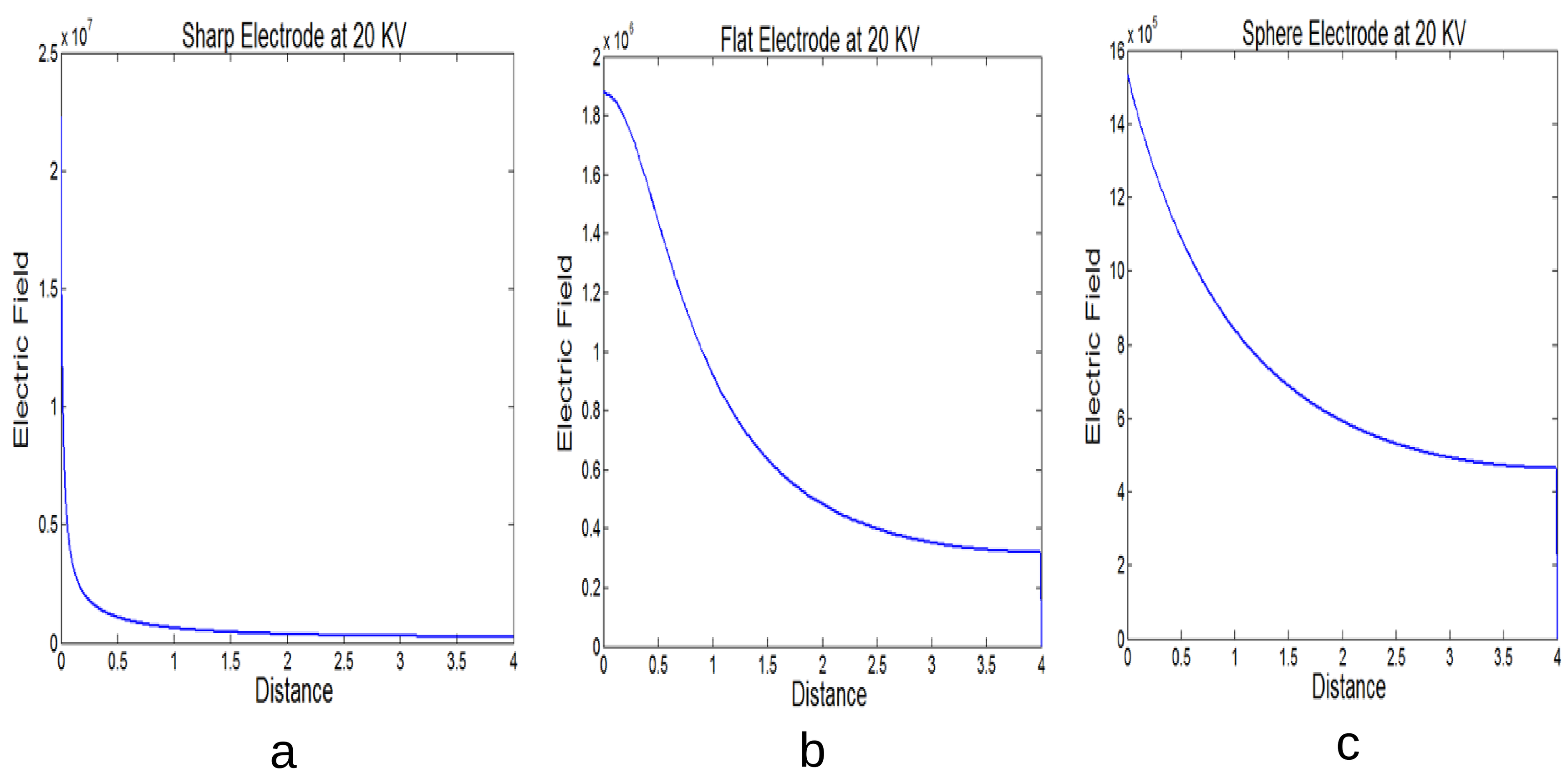

Figure 3. Electric field magnitude along the symmetry axis of the model; (a) sharp, (b) flat and (c) sphere electrodes under 20 kV applied voltage

Conclusions: The electrical field distribution for all types of the electrodes was successfully simulated using COMSOL Multiphysics software. It was shown that the electric field magnitude surrounding the tip of the electrode under high applied voltage influences the PD characteristics.

References:

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