# Partial Discharge Risk Under Charge Generation and Transport Effects

M. E. Banda[1], D. Malec[1], J-P. Cambronne[1]

[1]LAPLACE, Université de Toulouse, CNRS, INPT, UPS, France

## Abstract

The good electrical, thermal, mechanical and chemical properties of solid organic dielectrics, such as PTFE, predestine them as good candidates for the electrical insulation of transport devices and systems. In the particular case of power converters involved in the future hybrid and full-electric aircrafts propulsion systems, power busbars could be insulated by PTFE films. However, under both electrical (HVDC) and environmental (thermal cycle, humidity, pressure,...) operating constraints, the confinement requirements and the power densities increase, these insulators can accumulate space charges within their bulk. This charge accumulation increases the local electric field which can result in a premature degradation of fundamental properties of the insulator and thus alter the reliability of depending systems. At the same time, this increase can also favour a premature ionization of air surrounding the busbars and initiate highly harmful partial discharges. For all these reasons, a better understanding of charge generation and transport mechanisms responsible of these charges accumulation and the study of their impact on the initiation of partial discharges in busbars environment constitute a major technological challenge.

Based on a topological model from power busbars designed for hybrid aircraft propulsion, some simulations of partial discharges risks induced by charge accumulation in PTFE has been developed under COMSOL Multiphysics® through a new bipolar model of charge generation and transport. The model was implemented using comparatively the AC/DC interfaces and the Mathematics PDE interfaces. The simulation results, focusing on the appearance thresholds of partial discharges in air and the highlighting of generation and transport mechanisms which induce them within PTFE, show a significant impact of the nature, the quantity and the space-time distribution of accumulated charges on partial discharges inception in air. The unsteady simulation conditions of these charge accumulation testify, among others, the greatest partial discharge risks incurred by the busbar insulators under various charging constraints.