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Hybrid multiscale modelling to predict lightning damage on CFRP materials

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Abstract

Carbon Fiber Reinforced Polymers (CFRPs) materials are increasingly being used in the wind turbine industry to reduce weight in turbine blades. However, CFRPs have a particular issue when dealing with lightning strikes because of their anisotropic material properties; in particular, their electrical and thermal conductivities. These issues cause significant damage when exposed to large electric currents. This paper presents a time dependent coupled thermal-electric joule heating model to predict the thermal damage of a CFRP panel when subjected to a lightning strike. The approach of this model uses volume fractions to determine the resulting fiber and resin damage separately. The damage prediction is calculated by a set of pyrolysis equations. The pyrolysis damage alters the materials properties of the elements. The electric current applied to the panel is the 10/350 standard waveform which corresponds to the waveform used to test wind turbines according to the IEC61400 section 24 Ed 1.0.