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# Electrical Breakdown Model and Partial Discharge in Ceramic Dielectrics

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The Air Force Research Laboratory has been studying ceramic dielectric materials for high voltage pulsed power capacitor applications. As part of this effort, we have been developing an electric breakdown model for ceramic dielectrics using AFRL's massively parallel 3-dimensional electromagnetic particle-in-cell code, ICEPIC. First a method to generate randomly shaped polyhedral utilizing Voronoi tessellation was developed to simulate the ceramic material. Since electrical breakdown occurs when the local electric field exceeds the threshold electrical strength of the dielectric, breakdown was initially modeled as individual cells in the grid changing from an insulating state to a conducting states as an electric field is applied that exceed the local breakdown strength. It was also assumed that the grain boundaries of the ceramic have a lower breakdown strength that of the ceramic crystal. Details developing the electrical breakdown model of ceramic dielectrics and current progress is described. In addition, partial discharge (PD) measurements of high breakdown strength ceramic dielectrics has been performed using a Haefely Hipotronics model 750-10A6-EX-B partial discharge detector. This detector is capable of performing PD measurements with up to 50 kilovolts of applied voltage. PD measurements are presented on ceramic dielectrics before and after applying multiple pulses of increasingly higher electrical stresses. Relationships between the electric breakdown, partial discharge measurements and structure of the dielectric ceramic are discussed. This work was funded by the Air Force Office of Scientific Research through Laboratory In-house Research Program, LIR 16RDCOR281.

**Authors:** Dr HEIDGER, Susan (U.S. Air Force Research Laboratory); Mr LERMA, Al (Leidos, Inc.); Dr WATROUS, Jack (Confluent Sciences LLC)

**Presenter:** Dr HEIDGER, Susan (U.S. Air Force Research Laboratory)

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