Abstract Submitted
for the MAR10 Meeting of
The American Physical Society

Electrical Treeing Induced Vascular Networks for Fluid Transport

KRISTOPHER BEHLER, ERIC WETZEL, U.S. Army Research Lab — Electrical treeing (ET) is a stepwise dielectric breakdown process in which partial discharges in a dielectric material generate a branched hollow network of tubules between the electrode and the ground. Overtime, exposure of dielectric materials to global electric fields which are lower than the dielectric strength results in electrical trees (ETs). This dielectric breakdown is exploited to induce a controlled growth of ETs in epoxies to demonstrate a fabrication technique of synthetic vascular systems in engineering materials. Both AC, $\pm$20 kV at 100 Hz sine wave, and DC, up to -60 kV, voltages were used to grow ET in planar and volumetric systems. AC treeing induces a more bush-like highly branched structure, whereas DC treeing results in a more tree-like structure possessing mostly low ordered branches. In addition to voltage, the geometric arrangement of the electrode and ground, and the use of electrode surface treatments with multi-walled carbon nanotubes (MWCNTs) were investigated. Applications for vascular networks were demonstrated by filling the ETs with dyed liquids.

Kristopher Behler
U.S. Army Research Lab

Date submitted: 20 Nov 2009 Electronic form version 1.4