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Electrical Breakdown of Weakly-Conductive Liquids and Transition to a Supercritical Fluid.[1] SKYE ELLIOTT, SERGEY LEONOV, Univ of Notre Dame, ND TEAM — This experimental study reveals the high-voltage pulsed electrical breakdown of weakly-conductive liquid (MeOH) trapped in a dielectric test cell. It is considered a three-phase process with (1) mm-scale streamers propagation, (2) formation of a highly-conductive channel, and (3) transition of the discharge in liquid to in a supercritical fluid. Typical test conditions are: voltage applied U?10kV; electrical current I?100A; initial pressure P=1bar; maximal pressure within supercritical fluid P>100bar. The diagnostics include: electrical probes, fast camera imaging, schlieren visualization of hydrodynamic processes, laser tracking of interfaces, optical emission spectroscopy. The sequence of plasma formation and supercritical fluid generation were shown to be highly sensitive to electrode configuration and applied voltage, with lower voltages yielding a two-step delayed breakdown. A non-ideal plasma state is considered with electron density Ne>3e19 cm-3 measured by Stark broadening of Hα line. Study of mechanisms of electric breakdown and discharge dynamics in supercritical fluids is a fundamental challenge and promises well-recognized practical benefits, such as a fuel injection technique, protection against deadly breakdowns in electrically-insulating liquids, etc.

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