Seminar

Institute for Plasma Research

Title : Compact Pulsed Power using Liquid Dielectrics

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Date : 28th June 2016 (Tuesday)

Time : 11.00 AM

Venue : Committee Room 4 (New Building), IPR

Abstract:

In the recent past, the demands for pulsed power machines have increased to number of applications. Many such applications require compact and low weight pulsed power systems with high voltage output (>100 kV). The portability and compactness of pulsed power systems can be accomplish by using dielectric medium with high dielectric constant and good breakdown strength. In comparison with solid dielectrics, liquids and gases are self-healing. High dielectric constant and good breakdown strength make liquids more suitable for energy storage and as switch media compared to compressed gases, particularly for nanosecond pulse generators. Proper understanding of the breakdown properties of dielectrics will lead to improve the dielectric strength. Despite extensive research and theoretical studies, the understandings of electrical breakdown properties of liquids (like water) are far from complete.

In this work, an effort has been made to understand the electrical breakdown properties of water under nano second regime with the help of Tesla based pulse generator. Further, in order to understand to estimate the electrical breakdown properties of liquids, fast response electrical diagnostics viz., capacitive voltage sensor and self-integrating Rogowski coil are indigenously developed and calibrated using standard commercial probes. Experiments have been carried out by applying tens of nanosecond pulses and hundreds of kilo volts under uniform field conditions. The parametric effect like, effect of electrode material (Brass and Stainless steel) and change in distance between the electrodes on water breakdown properties have been studied. In addition, to understand the observed effect of electrode material (i.e. stainless steel and brass) is analyzed by using the optical emission spectra during the discharge. The spectra data confirms the presence of charge during discharge which suggests that the shielding effect at electrode surface reduces the electric field. The comparative study of electrical breakdown properties of deionized water (H2O) and heavy water (D2O) is presented with two different electrode materials (SS and Brass), and polarity (positive, negative) combinations. Further, to understand breakdown behavior it is attempted to know the change in chemical behavior in both liquids due to discharge by using optical Fourier transform infrared (FTIR) absorption spectroscopy. This enables a qualitative interpretation of the superior performance exhibited by H2O as a dielectric for compact pulsed power applications. In order to understand the physical processes of discharge initiation in the pulsed breakdown of liquids and the basic laws of formation and propagation of discharges in liquid a high speed fast optical photo recording(Stanford computer optics, 4 Picos, ICCD) camera has been used. The breakdown images present the initiation and propagation of streamer from the electrode into the dielectric medium in the nanosecond regime.