Plasma production and vapour layer production in saline solution.

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Keywords: Plasma, Liquid, Saline

Plasma production in liquids has largely been confined to those in water. They have been investigated for many decades and those studies have most recently been reviewed by Malik et al [1]. Most of the plasmas created in liquids to date consist of multiple micro-channel breakdown plasmas, similar to the corona plasma in high pressure gas plasmas. It appears that the breakdown channel creates a "vapour" channel into which the plasma energy is deposited. This normally requires large voltages (~10kV). In producing plasmas in liquids voltages with the polarity alternating at tens of kHz is found to be most effective and efficient.

Recently there have been interesting new studies of plasmas created in saline solution by applying moderate (< 300 V rms) bipolar voltage pulses [2-7] to electrodes. Interest in such plasmas has been prompted by their use in various surgical procedures.

However this environment may prove to be very conducive to the study of plasma production in liquids and in particular in elucidating the relationship between vapour layer formation and discharge formation. We report preliminary studies of the vapour layer and plasma formation in the vicinity of small metal electrode (~ 1mm diameter) immersed in saline solution and subjected to relatively low voltage (~200V), pulses. The device was imaged in backlight using a telescope and fast ICCD camera operating with a gate width of 100 microseconds. The dark layer over the surface of the active electrode is interpreted as caused by light scattering from a growing vapour layer. The time-sequence of images shows a vapour layer growing over the surface of the electrode prior to the initial light emission event; plasma formation. The electrical characteristics show an ohmic behaviour during the vapour growth phase with a distinct change on behaviour at onset of plasma formation. The vapour layer growth measurements are compared with finite element analysis-based simulations.

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