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Initiation Of Plasma Discharges In Saline Solutions

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Plasmas have been used in surgery for some time with well established techniques like surgical diathermy and newer methods [1][2]. The use of electrical discharges to ablate material has the added advantage that the material not removed is cauterized, which reduces blood loss. This application of plasma discharges in the body during surgery has inspired the present work.

In this presentation, work to investigate the formation of plasmas in saline and similar ionic solutions will be described. Normal saline has 9 g/l of NaCl in water. It is a useful analogue for human fluids as it is approximately isotonic to blood.

The breakdown of saline solution has been observed with optical methods and its electrical characteristics. Time resolved optical measurements have been made with fast framing and single shot iCCD cameras. These cameras have been used in time resolved shadowgraphy measurements to observe the spatial evolution of the liquid, vapour and plasma with time. The iCCD camera has also been used to measure time resolved optical emission spectra.

Different discharges have been observed. Microsecond pulses of a few hundred volts have been applied to 0.5 mm diameter electrodes with 0.5 mm length exposed to liquid and with a large earth plate located some centimetres from the powered electrode [3]. We have also more recently applied microsecond kilovolt pulses to a 0.25 mm diameter powered electrode located less than 0.25 mm away from a similar 0.25 mm diameter ground electrode in an end-to-end configuration where discharges are generated between the two ends of these electrodes. The results obtained from these experiments with very different electric field strengths will be compared in this presentation. A simple theory has been proposed, which predicts the time taken between pulse application to discharge initiation [3]. The performance of this theory will be examined with a wide range of different conditions.

References

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