# Diaphragm discharge ignition supplied by DC non-pulsing voltage in electrolyte solutions with different conductivities

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## 1. Introduction

Electrical discharges generated directly in liquids or direct plasma interaction with liquid phase is one of the hot topics of the contemporary plasma research. The plasma in water solutions can be generated by various electrode configurations, and it can be supplied by many kinds of the applied voltage from DC up to MW frequencies using pulsed as well as non-pulsed regimes [1, 2].
The presented contribution deals with the direct observation of the pin-hole discharge breakdown in water solutions. In this case, both electrodes are immersed inside the liquid phase, and the electrodes are separated by a dielectric barrier with a small orifice. If the aspect ratio (thickness/diameter) is about 1 (thin barrier with a relatively big orifice), the discharge is called the diaphragm discharge; if the aspect ratio is much higher than 1, the discharge is called the capillary discharge. The non-pulsing DC voltage was used for presented study. The time resolved current-voltage characteristics were applied for the discharge breakdown determination [3, 4].

## 2. Experiment

The batch discharge reactor (volume of 110 ml) was used for this study. The stainless steel electrodes were separated by the Shapal-M$^{TM}$ ceramics. Two diaphragms with one central orifice (diameter of 0.3 mm) with thickness of 0.6 and 1.5 mm were used for the contemporary experiments. NaCl solutions with conductivity of 275, 400, 550, 750, 980 μS·cm$^{-1}$ were prepared. The discharge ignition arises in the middle of the reactor at the edge of the diaphragm.

Diagnostics of the system were performed by a two channels Tektronix TDS 1012B oscilloscope. The high voltage was measure between electrodes, the currents was measured from voltage drop on ballast resistor (5 Ω).

## 3. Results

The measured mean current-voltage characteristics are given in Figs. 1 and 2. The current density increases inside the pin hole and thus the microbubbles are generated, here. The discharge is consequently ignited in these microbubbles. Due to the fact that resistivity (and thus Joule heating) is indirectly proportional to the conductivity the breakdown voltage decreases and breakdown current increases with the solution conductivity increase. The breakdown voltage as well as breakdown current is higher in the case of thicker dielectric barrier (i.e. in capillary configuration) because of the higher resistivity at capillary part of the whole discharge-solution interelectrode system. The lower stability of the thinner diaphragm system is due to rapid movement of the microbubbles out of pin-hole.

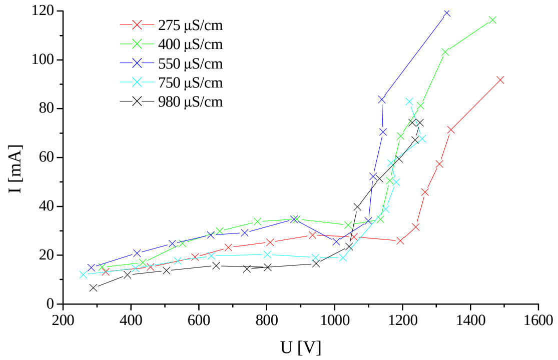


Fig. 1. *Mean current-voltage characteristics (pin-hole diameter of 0.3 mm, thickness of 0.6 mm).*

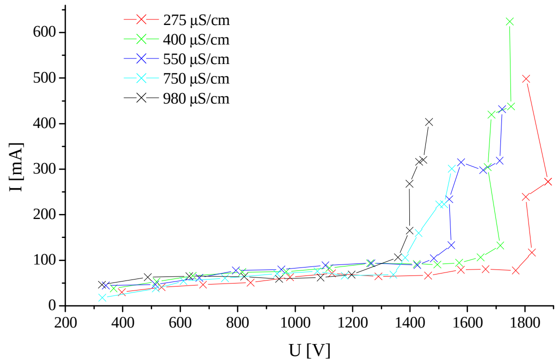


Fig. 2. *Mean current-voltage characteristics (pin-hole diameter of 0.3 mm, thickness of 1.5 mm).*

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