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PLASMA GENERATION IN THE GAS CAVITIES DURING DISCHARGE IN SALINE SOLUTION*

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The paper deals with the investigation of the pulsed discharge in saline solution (30 g of NaCl per litre) between the point electrode *3*, whose diameter is 1.4 mm and length is 7.5 mm, and the return electrode *4*. The capacitance $C_0 = 40$ μF is discharged via the interelectrode gap by means of switch *S*. The gap resistance in the initial condition is $R_0 = 12\ \Omega$. When the voltage pulse is applied to the gap, the gas cavities in the form of microbubbles appear in a vicinity of the point electrode due to the process of boiling. These microbubbles merge with each other thus forming a macrobubble similar to that shown in Fig. 1.

According to the generally accepted approach, the gas discharge can appear if only the surface of the active electrode is completely covered by the vapor cavity [1–3]. Then the electrode becomes shielded from the bulk of solution so that the whole voltage is applied to the gas cavity. If this voltage is sufficient to provide breakdown in the narrowest place, the gas-discharge plasma arises. Such a case is realized in our experimental conditions when the initial voltage at the gap reaches a critical value $V_0 = V_{cr} = 1000$ V.

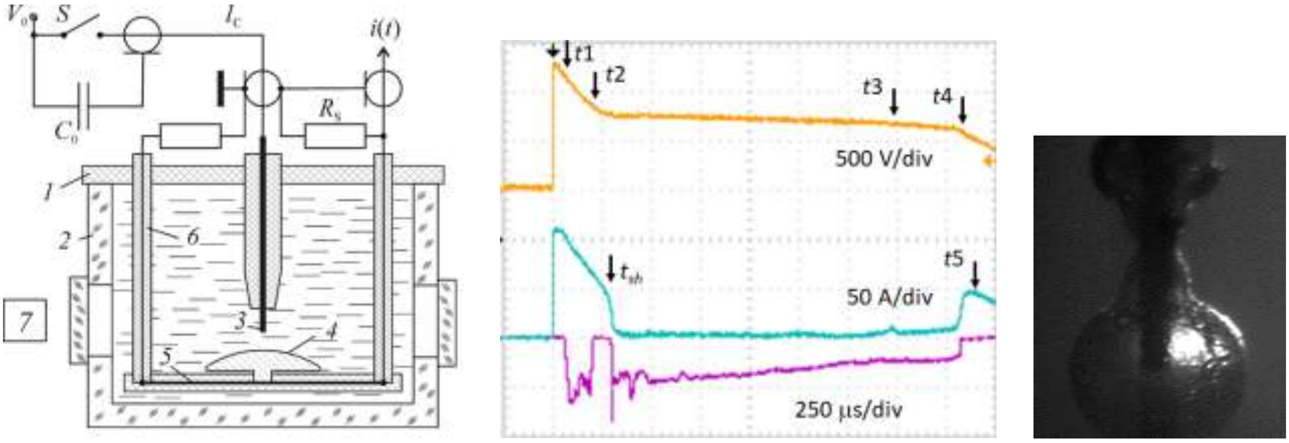

Fig.1. Experimental arrangement, the waveforms of voltage, current and PMT signal jointly with the photograph of macrobubble.

This paper demonstrates that the discharge is able to be initiated even if the active electrode is not covered by the vapor cavity completely. This situation is characteristic of the conditions when the initial voltage V_0 exceeds the critical value. The statement is illustrated by the waveforms in Fig. 1. It is seen that at the instant $t_{sh} = 275$ μs the current decreases abruptly i.e. the macrobubble prevents the current passage in the gap. The PMT signal shows the availability of a low-current glow-type discharge inside the macrobubble. Nevertheless, we can also observe the PMT signal starting from the instant $t1 = 50$ μs when there is no the complete electrode shielding. The discharge arises in the thin gas layer at the tip of the active electrode. After a time interval of 150 μs to the instant t2 = 200 μs, the discharge disappears since the voltage decreases to $V(t2) = 850$ V, and this voltage is not sufficient for discharge sustaining.

One more effect, which is observed in the experiment, is the sharp destroying of the macrobubble and cleaning of the electrode surface from the gas cavities. The process of destroying begins at the instant t4 = 2075 μs. The solution enters in the direct contact with the electrode surface, which leads to a fast increase in the gap current. To the instant $t5 = 2150$ μs the gap resistance acquires the initial value $R_0 = 12\ \Omega$.

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