INITIATION OF ELECTRIC DISCHARGE. METHOD OF COVERING THE ELECTRODE

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Basically all electrohydraulic technologies include «electrohydraulic effect». «Electrohydraulic effect» is the transformation of electrical energy into mechanical by powerful discharge in liquid [1]. One of the main problems associated with using electrohydraulic technologies is the ability to form a discharge channel in a conductive medium such as technical water, cement and clay drilling fluids [2]. The increase of working liquid conductivity leads to dramatically increase of pre-breakdown losses. Electrode coating by a dielectric layer allows significantly reducing working gradients, tracing the breakdown spot in order to ensure the task geometry and reducing power losses. The basic feature of this method is the use different coating materials to initiate the discharge in conducting liquids. Such initiation of electric discharge in liquid has several advantages comparing with others. It allows making a discharge in high conductive liquid and decreasing the voltage level [3].

The main goal of the project was to create a computer simulation of electrodes covered by different materials using ELCUT software and then to compare the experimental data with the computer model. The end of the pointed part was cut and stayed uncovered. Firstly the electrode without coating was considered (Figure 1).

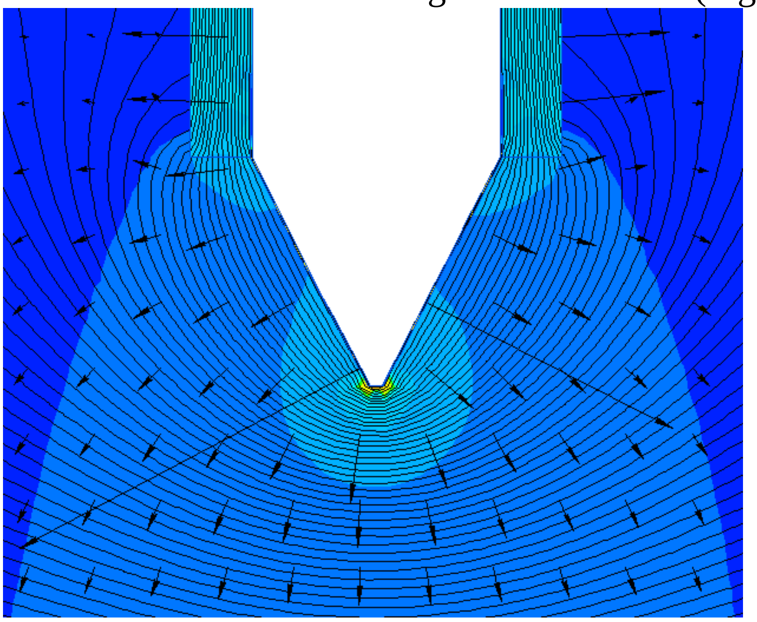

Figure 1. Field strength of the electrode without coating

In accordance with the values of electric field strength obtained by simulation we can conclude that the discharge will star its developing from the end of the electrode and partly from the triple point (meeting point of metal, isolation and dielectric). Now let us compare the results obtained in the course of the experiment with the computer model.

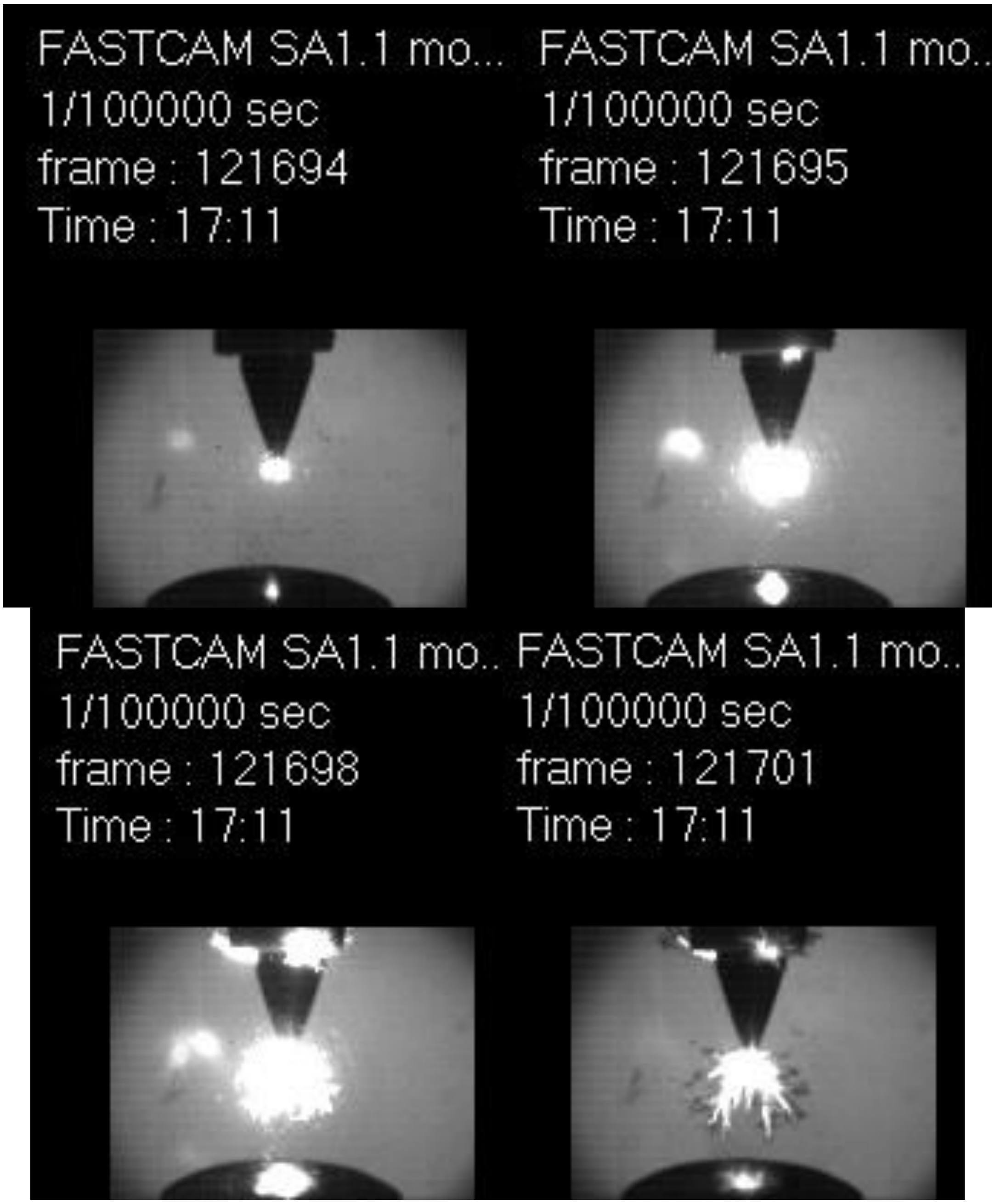

Figure 2. Fast camera frames

As we can see in the photo (2) the discharge really starts from the electrode tip and its triple point. Then the experiment was conducted with ceramics ($\varepsilon = 20$) coating.

ELCUT is able to simulate discharge in different environment accurately which enables to study the effect of a coating material without using laboratory equipment.

We also conducted simulation with polystyrene($\varepsilon = 22$) and came to the conclusion that the higher the dielectric constant is the higher field strength at the electrode tip.

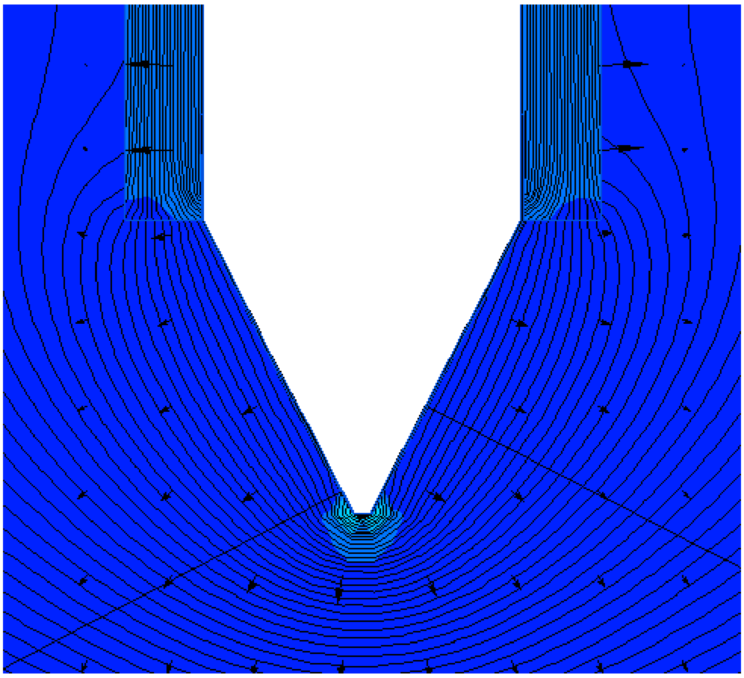

Figure 3. Field strength of the electrode covered by polystyrene

In order to check this conclusion we made simulation with strontium titanate ($\varepsilon = 310$). If our assumption is right the field strength will be at the electrode tip.

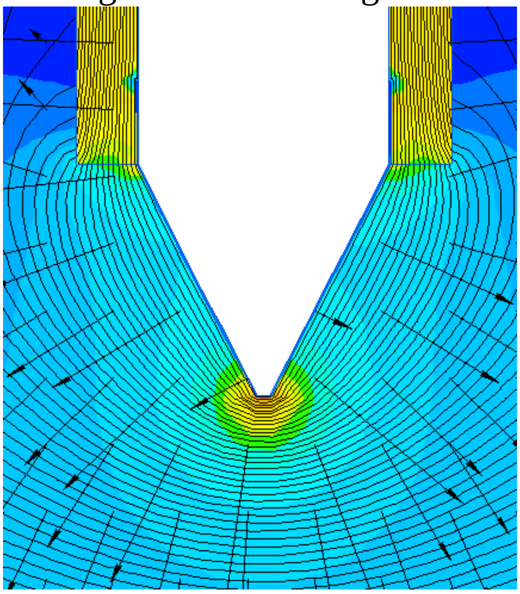

Figure 3. Field strength of the electrode covered by strontium titanate

As we can see in Figure 3 our assumption concerning the effect of dielectric constant on the electrode tip was true.

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