Microwave capillary discharge as way to influence biological objects

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We have studied microwave capillary discharge influence on culture of healthy and tumor cells. A experimental setup of microwave capillary discharge excite have been made. The discharge influenced the cell cultures. We have shown the possibility of local effects of the plasma filament on the viability of live cells with a high potential therapy for primary and secondary cancer formations. We used the culture of tumor cells Hela and prostate cancer and cell culture of fibroblasts as objects of our research. The authors assume the use of standard chemotherapy with plasma influence to increase the effectiveness of the therapy of cancer formations by rising the permeability of cell membranes.

We have studied microwave capillary discharge influence on culture of healthy and tumor cells. The experimental setup scheme of microwave capillary discharge treatment of cell cultures is presented on fig. 1. We have used the coaxial waveguide with the shortened central electrode (the inner conductor). The inner conductor is shorter than outer electrode (conductor) (2). The central electrode is hollow and also serves as a gas pipeline. The outer electrode (2) is grid with cells which size provides almost complete shielding of the microwave radiation and allows the discharge monitoring and measurement of its parameters. The discharge (4) was excited in a quartz capillary (3) which has been tightly fitted on the central electrode. The inner diameter of the quartz capillary is d_c=1-1.5 mm. The discharge influenced the cell cultures. Argon was used as a working gas in our experiments. The microwave radiation frequency was f=2.45 GHz. The microwave power in the pulse was P=2 kW. The pulse duration was ranged from 10 till 20 mcs and the pulse repetition rate was 50 Hz.

As shown in [1,2] the plasma torch generated contracted (diameter 200 μm) plasmoid (plasma filament) with electron concentration $n_e = 10^{16}$-10^{17} cm^{-3} in each pulse. The electron temperature was $T_e \approx 2$ eV.

We have shown the possibility of local effects of the plasma filament on the viability of live cells with a high potential therapy for primary and secondary cancer formations. We used the culture of tumor cells Hela and prostate cancer and cell culture of fibroblasts as objects of our research. MTT-test was used to evaluate the viability of cell cultures. The authors assume the use of standard chemotherapy with plasma influence to increase the effectiveness of the therapy of cancer formations by rising the permeability of cell membranes. This study is supported by Russian Science Foundation, project number 17-19-01583.

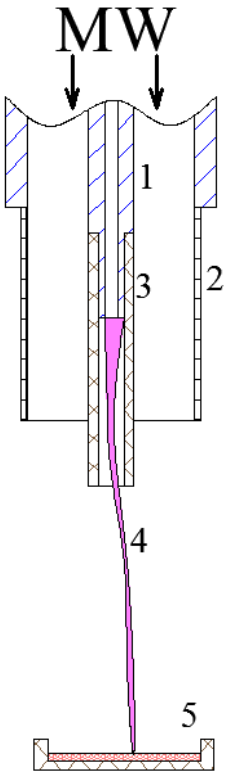

Fig 1. Scheme of experimental setup.

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