

# OPTIMIZATION OF PULSED VOLTAGE CAP JET MULTIPLE TREATMENT IN VIVO

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Analysis of antitumor and antimetastatic effects of the cold plasma jet treatment with pulsed voltage generation was done with the results of the experiments in vivo. Prior bio experiment with animals the CAP operation mode was optimized in the fluid simulations and with the measurement of plasma jet characteristics. In simulations, for an estimation of different regime efficiency the total energy input in excitation and ionization near the surface was calculated. In the experiment, the discharge current near the target was measured, as well as the emission spectra and the surface temperature of treated target. The cancer cells of different types were exposed to CAPJ generated with different regimes of pulsed and sinusoidal voltage [1]. The results of the treatment with sinusoidal regime and pulsed regimes with different pulse duration and frequency were compared. The most efficient regimes were used for the animal experiments. CT26 tumor cells were transplanted Balb/C mice subcutaneously. Animals were divided into groups of 6-7 mice each. The CAPJ treatment started 9 days after tumor cell transplantation, when tumors in all animals were well palpated and tumor nodules was  $32.6 \pm 2.0 \text{ mm}^3$  in size. During exposure we measured the temperature in the zone of contact of plasma with the animal skin using the Testo 872. The treatment was repeated 5 time every 48 h. The results of the treatment shown in Figure 1 indicate that the most efficient CAPJ modes are with sinusoidal voltage and pulsed voltage with the 7  $\mu\text{s}$  pulse duration. For these cases the measured tumor size was smaller, the metastates were not found and 80 % of mice with tumor were alive at the end of the experiment.

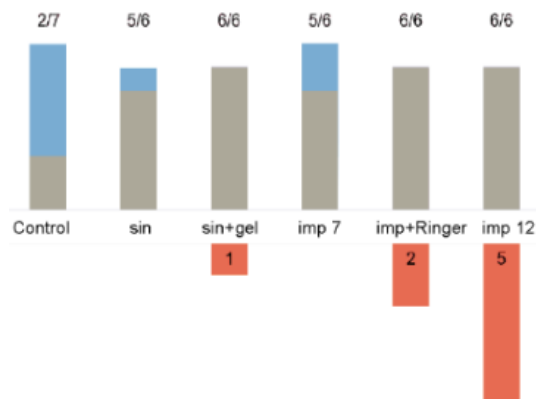


Figure 1: Survivors (grey), dead (blue) and with metastasis (red) on 23<sup>rd</sup> day, after the 5 times CAPJ treatment every 48 h. Untreated (control), treated with sinusoidal voltage CAP (sin) and with pulsed voltage with pulse duration of 7  $\mu\text{s}$  (Imp 7) and 12  $\mu\text{s}$  (Imp 12). For sinusoidal voltage CAPJ,  $U=2.9 \text{ kV}$ , 50/4 kHz, 9 l/min, 2 min. For pulsed voltage CAPJ,  $U=4.2 \text{ kV}$ , 25 kHz, 9 l/min, 2 min, helium.

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## References

- [1] Schweigert I., Zakrevsky Dm., Gugin P., Milakhina E., Biryukov M., Keidar M., Koval O.A. *Plasma Sources Sci and Technol.*, **31**, 114004 (2022).