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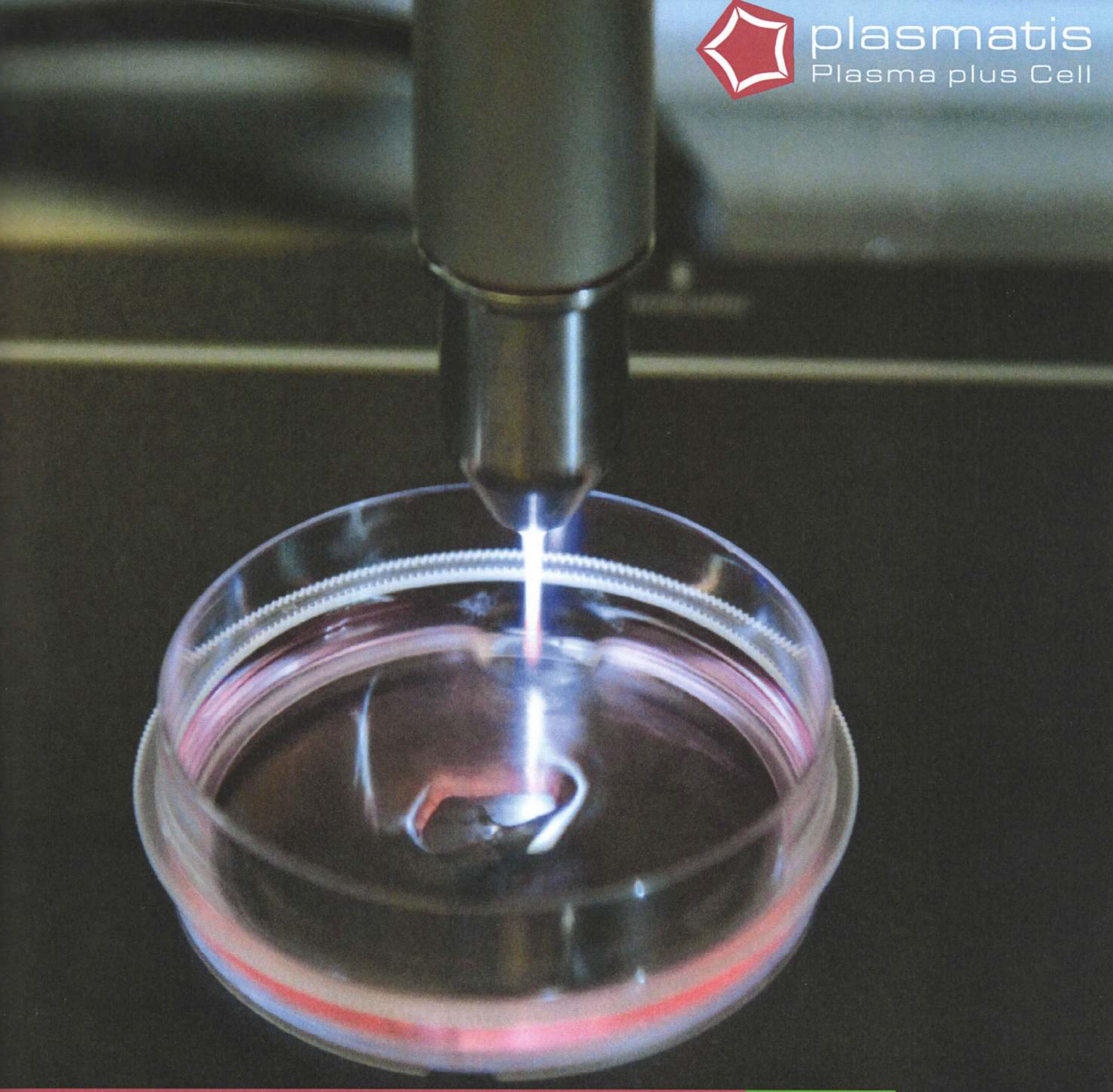

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# Decontamination of *E. coli* on inner wall of quartz tube by pulsed corona discharge and *Streptococci* biofilm by DC corona discharge

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**Abstract**
Low temperature plasma is a useful tool for decontamination of thermo sensitive materials (plastic surfaces, tissue, etc.) for which conventional methods such as autoclave and dry heat cannot be used. In the case of small diameter long tubes used in medicine (such as catheters or endoscopic multi-purpose tubes), flowing afterglow/post discharge can be forced through and decontaminate the tube inner wall [1, 2]. Cold plasma of corona discharges has been successfully demonstrated to inactivate biofilm on plastic surfaces [3].

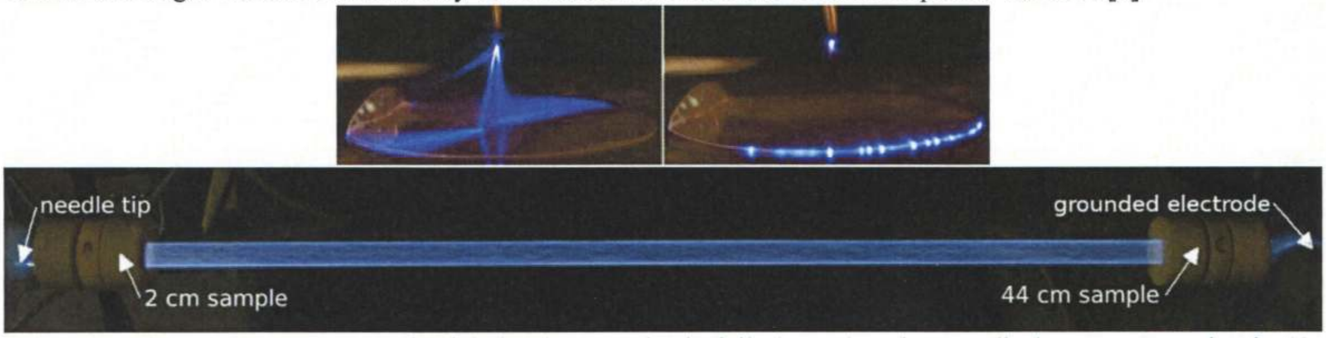


Figure 1. The streamer corona and Trichel pulses on plastic foils (upper) and argon discharge propagating in 49 cm long quartz tube (lower)

Decontamination of 24 h-old *Streptococi* biofilm on polypropylene surfaces was studied by positive streamer corona and negative Trichel pulses. The discharge chamber in air contains a sharp hypodermic injection needle as a high-voltage electrode opposite to a grounded copper plate at 0.5 cm distance. In some experiments, tap water was electro-sprayed through the discharge on the sample. Positive streamer corona with electric current pulses with frequency 20 kHz was supplied with a DC high voltage up to 10 kV. Negative Trichel pulses were supplied by 8 kV DC and current pulses frequency was 500 kHz. Biofilm was exposed to the discharge for 2, 5 and 10 min. 10 min exposure time caused a bacterial population reduction up to 2.5 logs for both polarities. Experiments with water spraying (two flow rates 0.01 a 0.05 mL/min were tested) with biofilm exposure time of 2 min showed that water spray significantly increased the $\log_{10}$ reduction from 0.95 up to 3.3.

For bio-decontamination of narrow tubes, we used an atmospheric pressure argon pulsed corona as a plasma source. The discharge was propagated in 49 cm long quartz tube with 8 mm inner diameter on its inner wall, with argon as a working gas (flow rate 3.5 – 4.2 slm). Positive high voltage pulses (25 kV peak, 2.2 μs width, 25 ns rise and fall times, 500 pulses per second) were applied to a tungsten needle electrode placed at the tube inlet. The grounded electrode was placed at the tube outlet. *Escherichia coli* was used as a model organism for evaluation of bacterial survival in the discharge. Two 10 μl droplets of bacterial suspension ($10^8$ bacteria/mL) were deposited inside the tube at 2 cm and 44 cm distance from the tungsten tip. The bacteria were exposed to the discharge for 5, 10 and 20 min. The gas flow without discharge was used as a control experiment. 20 min exposure time caused reduction of bacterial population in distant location (44 cm) up to 3 logs. Adding a water vapour (720 ppm) to the gas flow caused a significant enhancement of the biocidal activity of the discharge by about 1 log. Similar effect of water was observed in previous surface decontamination experiments with DC corona [3]. In argon only flow, we suppose the bactericidal effect is due to the action of excited Ar*. In argon with water vapor admixture, the formed OH radicals, UV B radiation (OH* emission at 308 nm) and to a lesser extent formed $H_2O_2$ contributed to the effect.

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**References**

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