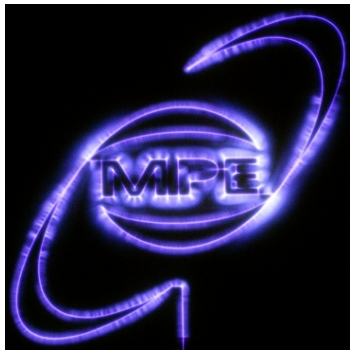
A new design of dielectric barrier discharge for surface self-sterilization

Yangfang Li (yfli@mpe.mpg.de)

T. Shimizu, J. Zimmermann, and G. Morfill

Max-Planck-Institute for Extraterrestrial Physics, 85741 Garching, Germany

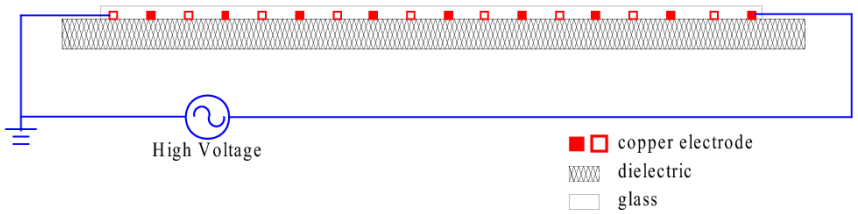


GEC-ICRP, Oct. 4-8, 2010, Paris, France

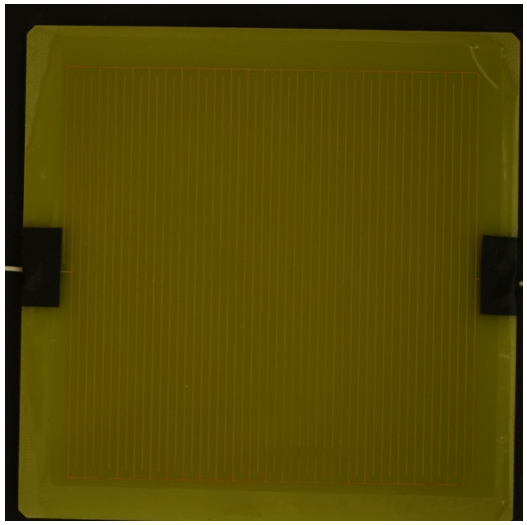
Outline

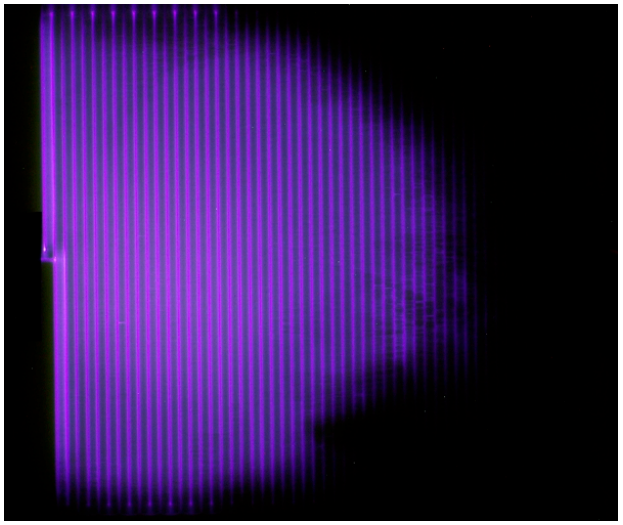
- Introduction
  - electrode, operating modes, material, plasmas
- Bacterial experiments
  - indirect and direct bactericidal effect
- Possible applications
  - water and dust resist, scalable design, flexible surface
  - kitchen tables, work benches, touch screens, and so on
- Summary and outlook
  - prototype, life time testing, safety testing, industrial products…

Introduction (1)



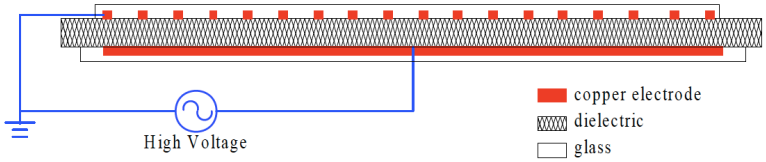
- plastic glass surface (~ 0.2 mm thick)
- two wire electrodes (distance ~ 2 mm, wire thickness 0.1 mm)
- epoxy board (thickness ~ 1.5 mm, 12 cm x 12 cm)
- electrode area (10 cm x 10 cm)



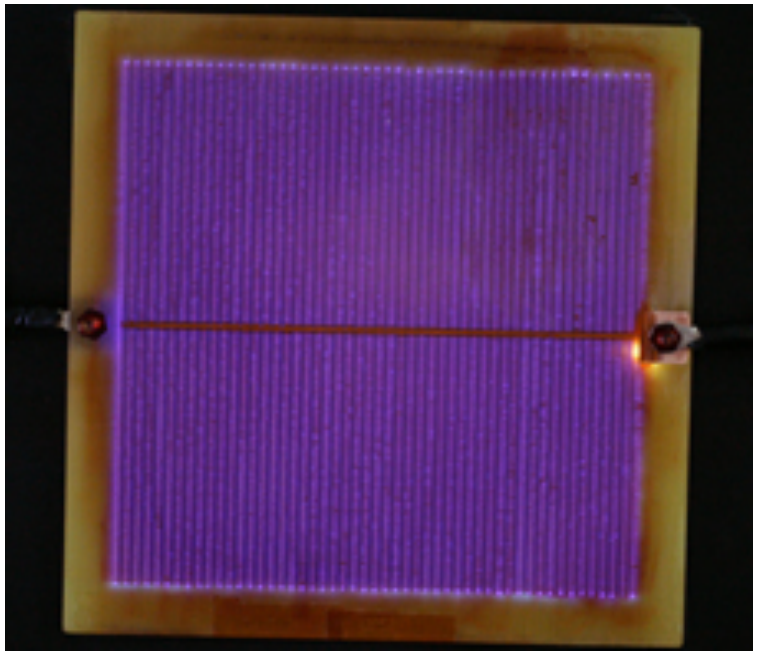


2kHz, 22kVpp, sine wave

Introduction (2)

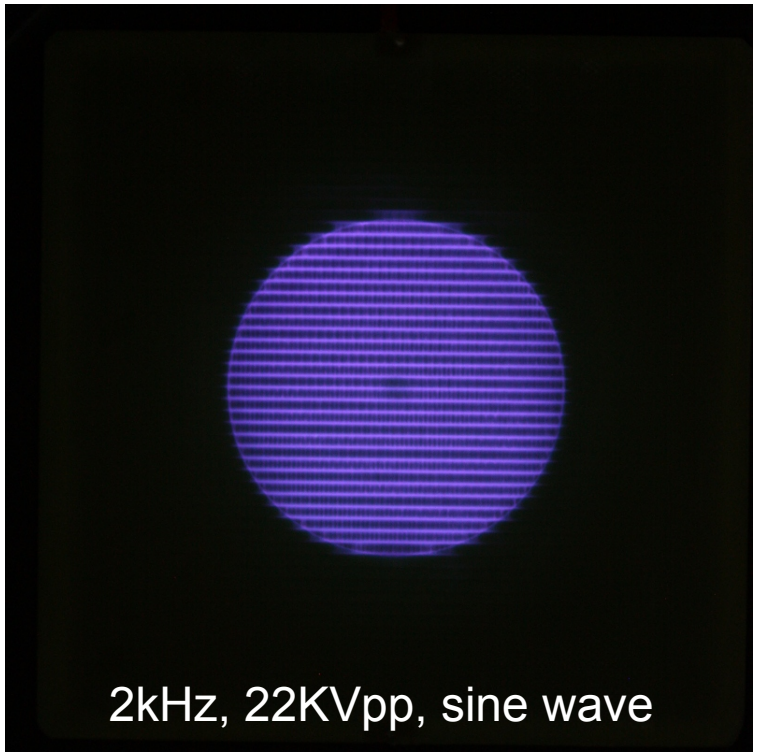


- glass epoxy surface (~ 0.1 mm thick)
- one wire electrode (wire 0.1 mm x 0.2 mm)
- epoxy board (thickness ~ 1.5 mm, 12 cm x 12 cm)
- electrode area (10 cm x 10 cm)

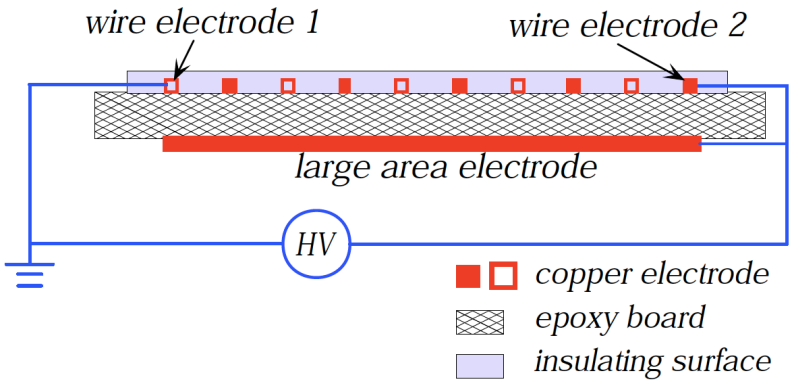


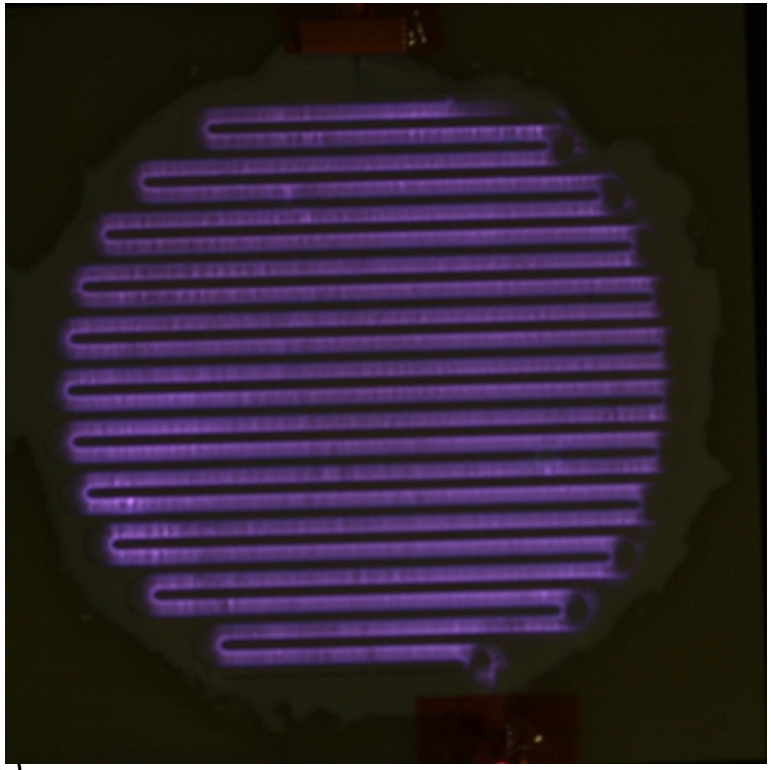
1kHz, 14kVpp, sine wave

Introduction (3)



Introduction (4)

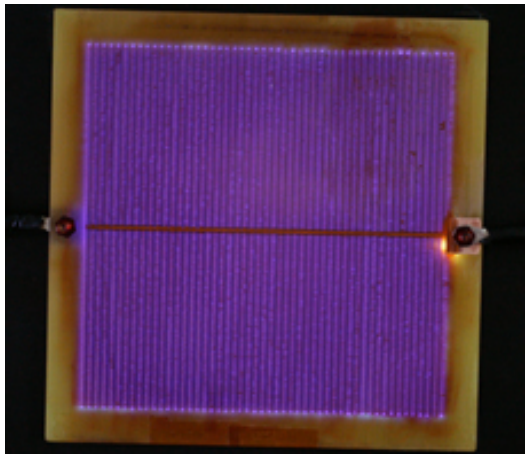


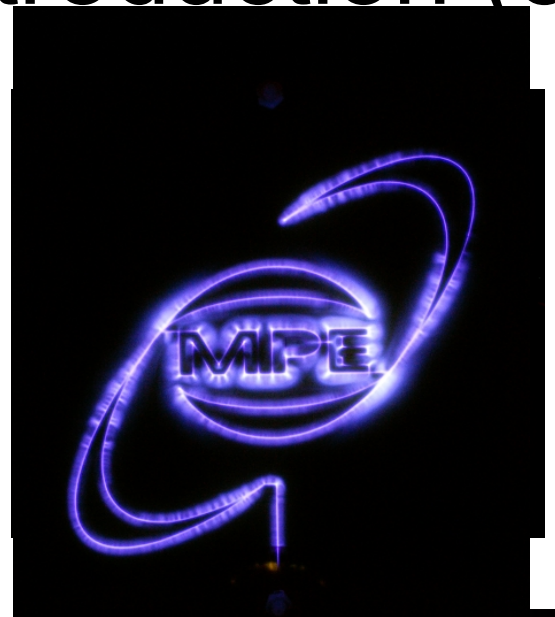


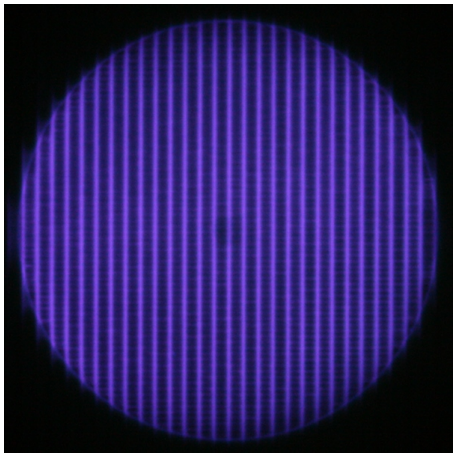
- glass epoxy surface (~ 0.2 mm thick)
- two wire electrodes (wire 0.1 mm x 0.2 mm)
- epoxy board (thickness ~ 1.5 mm, 12 cm x 12 cm)
- electrode area (9 cm in diameter)

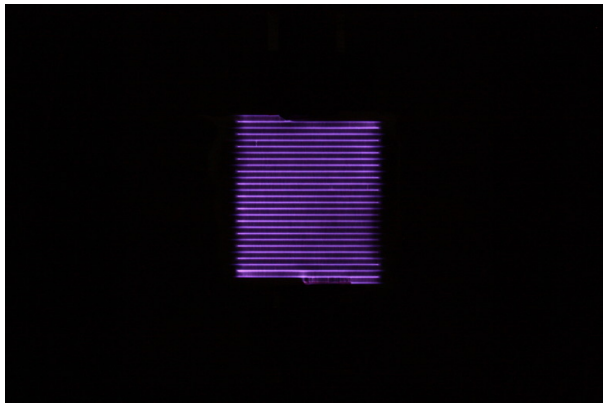
2kHz, 18kVpp, square wave

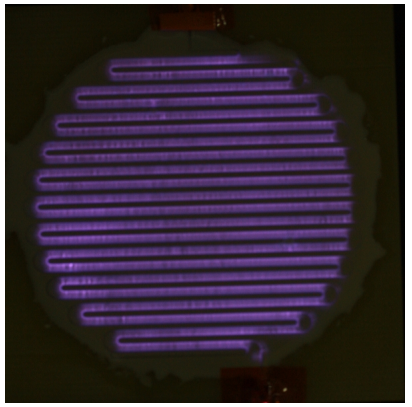
Introduction (5)





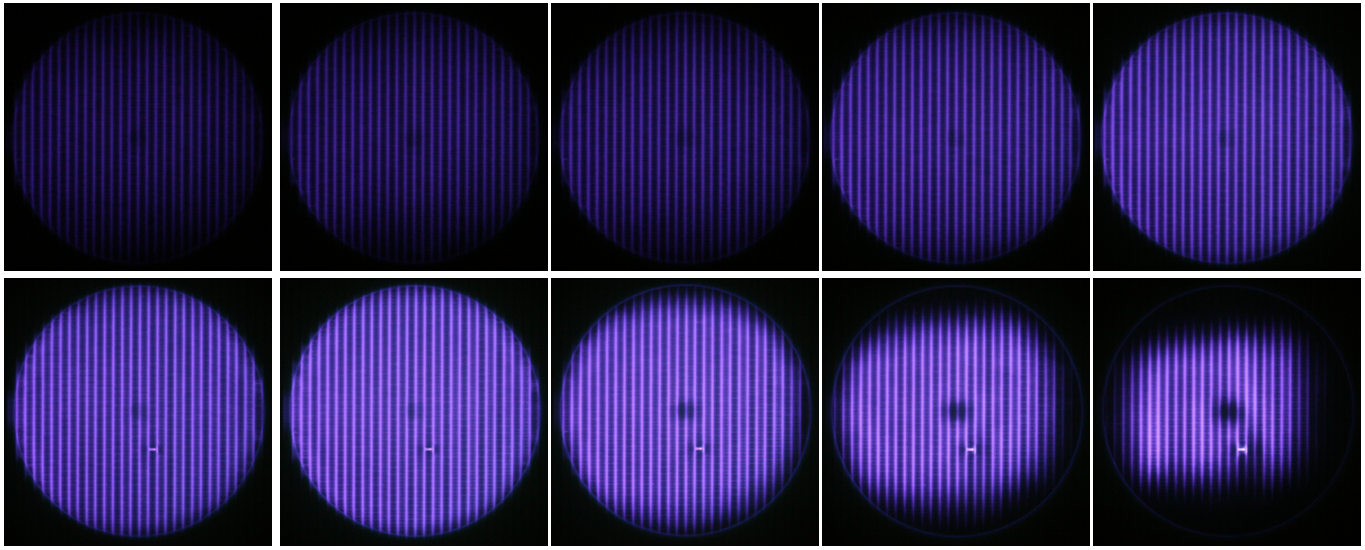




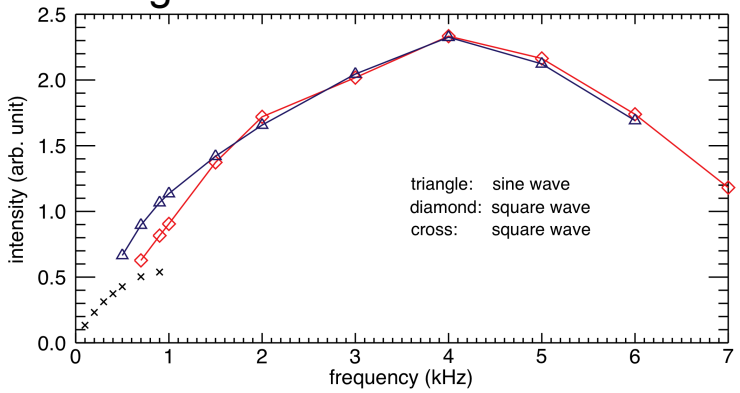


Introduction (6)

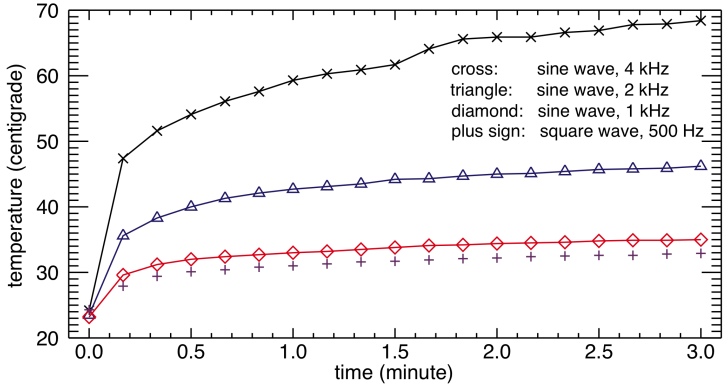
Images of discharge with different frequencies (square wave, 0.5-7kHz, 22kVpp)



sum of image index

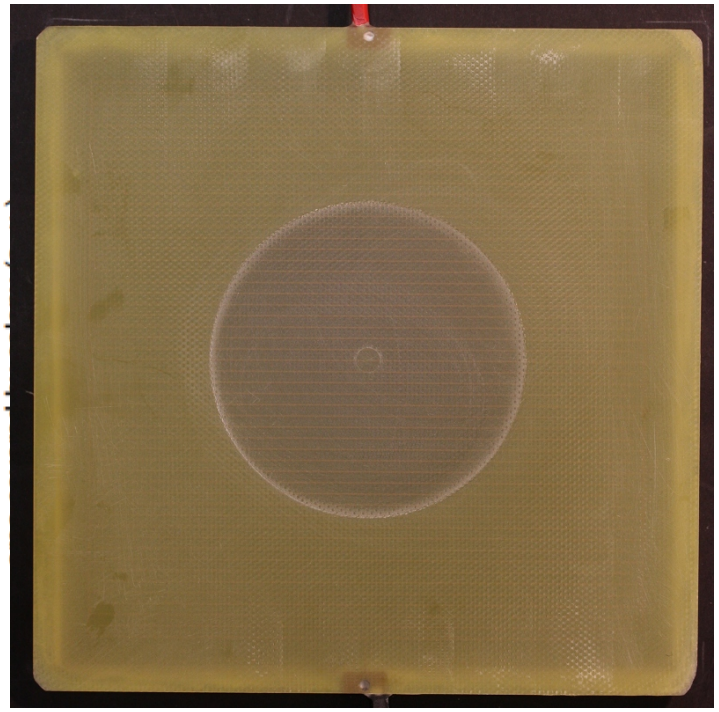


surface temperature Voltcraft 320 K/J



UV power: < 1 microWatt, ozone: < 5ppm

Bacterial experiments (1)



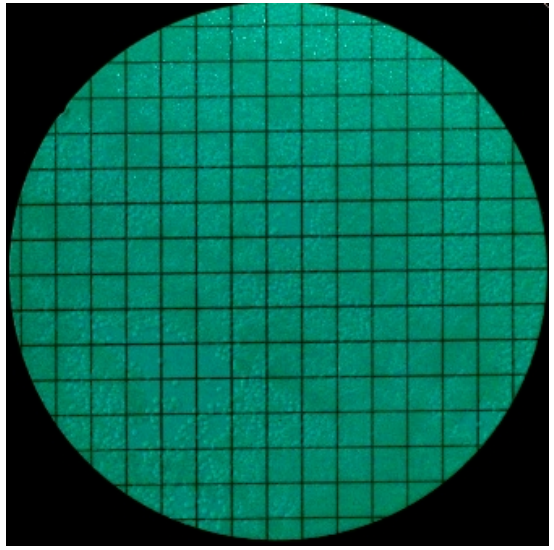
with membrane filter*

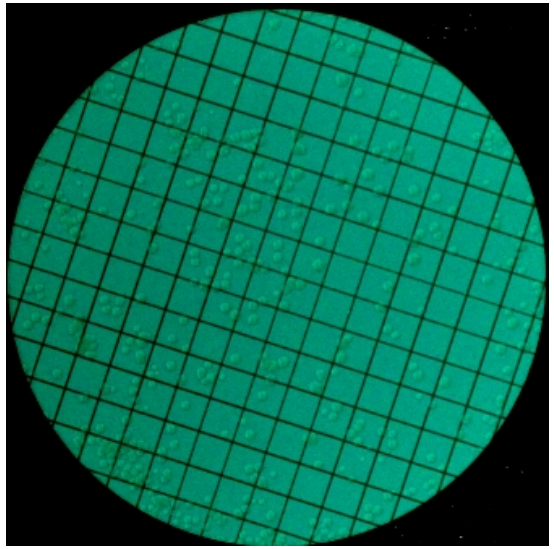
Escherichia coli

30 seconds plasma exposure

16 hours for incubation

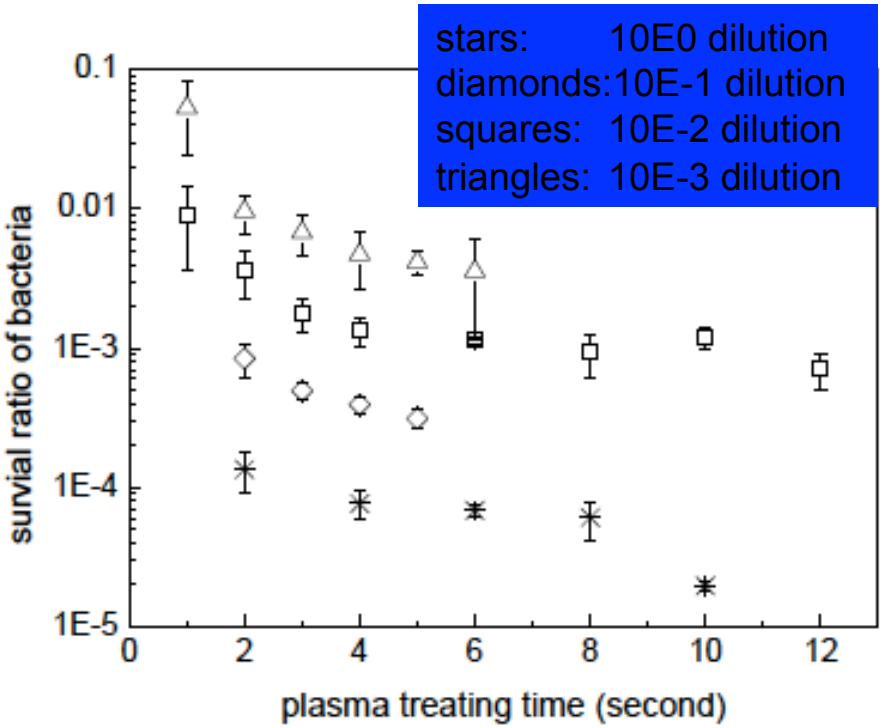
1 kHz, square, 22 kVpp

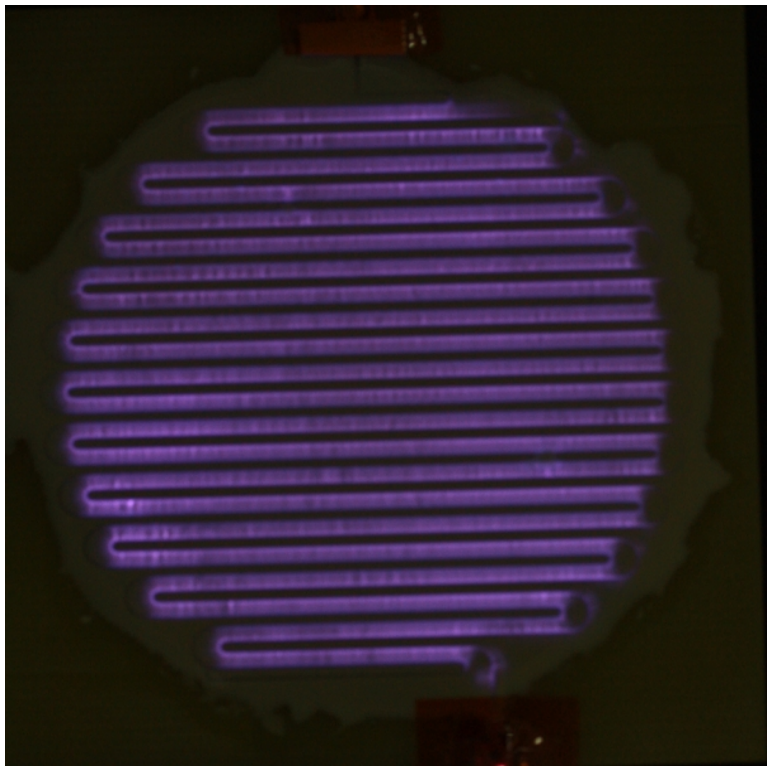




Cellulosenitrate filter with pore size of 0.45 micrometer
Provided by Klinikum Schwabing.

Bacterial experiments (2)





2kHz, 18kVpp, square wave

bi-phasic structure of the survival curves →
Boudam and Moisan, J. Phys. D, 2010

Possible applications

water and dust resist, scalable, and flexible

http://www.spiegel.de/netzwelt/gadgets/0,1518,712443,00.html
Thank Tobias for the information.

Summary and outlook

- SSS with different surface materials were tested.
- Breakdown voltage varies from 15 kVpp to 24 kVpp in a frequency range between 0.1 kHz and 7 kHz.
- Direct and indirect bacterial experiments were conducted

  - Optimization of SSS

    Material, surface thickness and evenness

  - Characterization of SSS.

    UV emission, power consumption, ozone rate, bactericidal effect

  - Life time, safety issue

    → prototype → industrial product

Thank you
for your kind attention.