

Hes·so/// Study of large area, atmospheric and sub-atmospheric plasma sources for decontamination of food powder

SWISS PLASMA CENTER



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Objectives

- Plasma exposure is a proven efficient means of sterilization

Plasma interaction with biological organisms



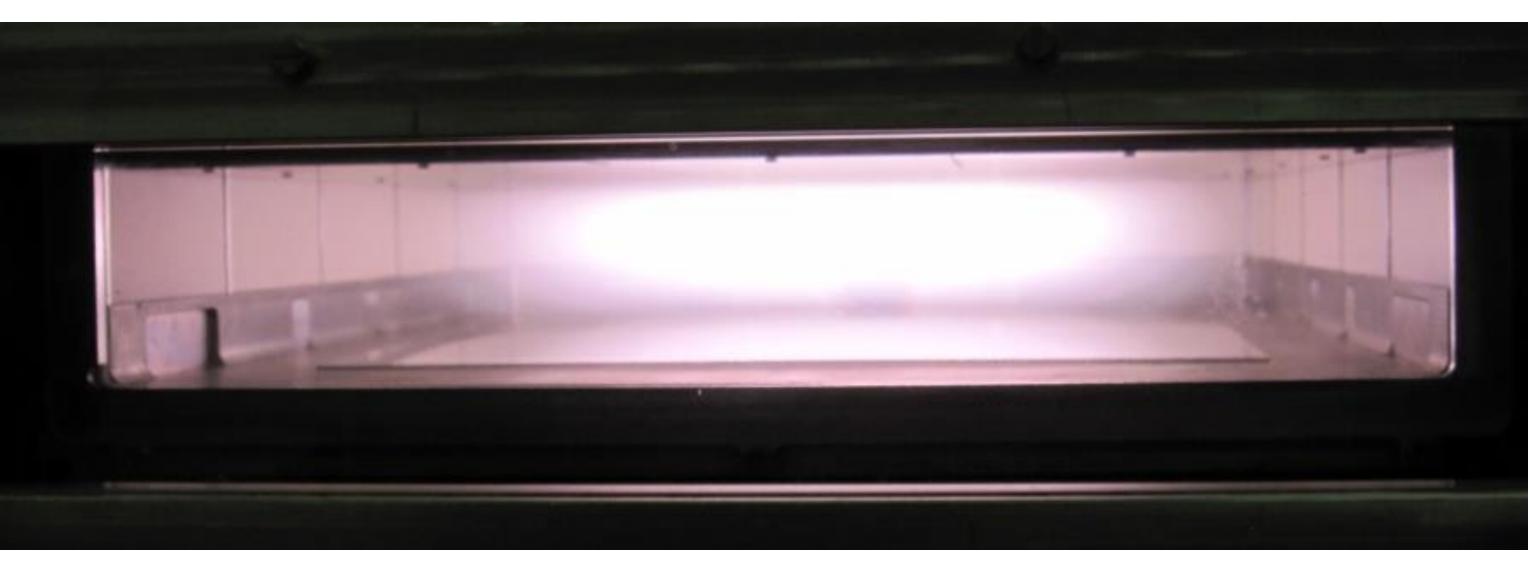
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School of π Engineering

- Industrial application requires large area and large volume sources
- Conventional plasma sources have to be adapted for higher pressures
- Intermediate pressures (100 200 mbar) are advantageous for:

i) Higher volume than for atmospheric plasma sources

ii) Higher fluid dynamic forces than for low pressure (mbar) plasma



Example of a large area plasma reactor 1 m x 1m

Plasma is a neutral medium

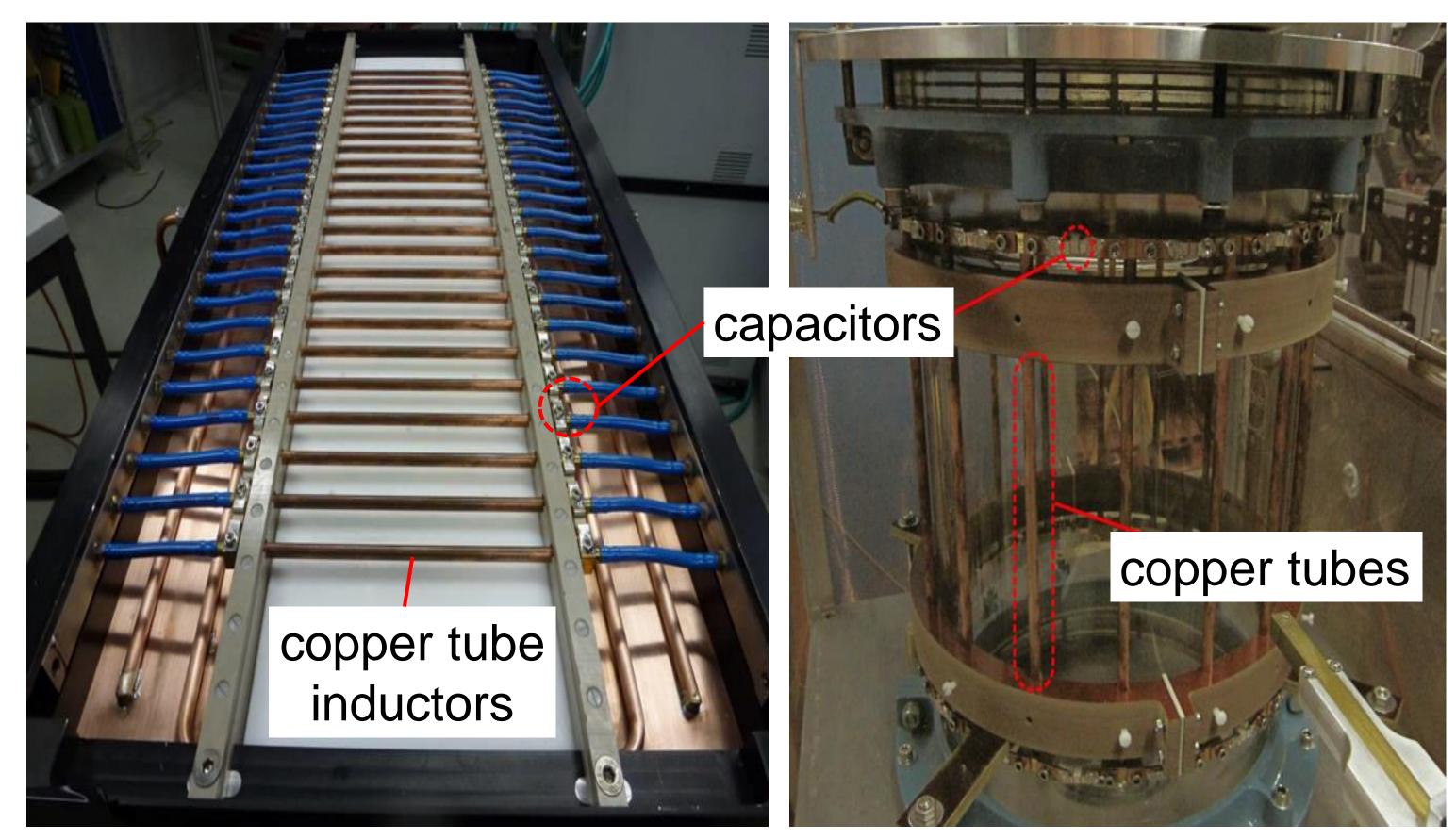
A Plasma ions play key role Role of positive and negative ions is related to catalysis of peroxidation processes in presence of reactive oxygen species. Eukaryotic cell 7577 Prokaryotic ce Primary target is cell membrane Peroxidation of phospholipids and polysaccharides is 0000000000 catalyzed by charged species. Water is required and effect of surrounding medium is important. 0000000000 Intracellular biochemistry Lipid layer peroxidation leads to intrace ular pathway activation (i.e. malondial dehyde, MDA formation) which alters DNA structure. Selectivity Tissue sterilization without visible or microscopic (histological) damage; selective development of apoptosis in cancer cells; difference in metabolism of peroxidation products; etc. Effect of dose Low doses: sterilization, blood coagulation.

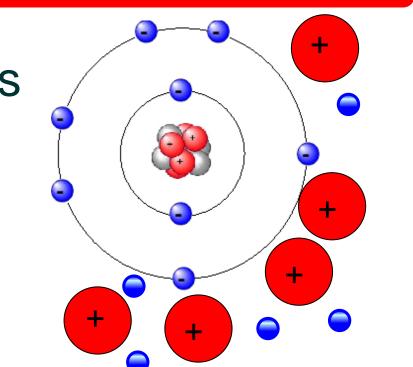
Intermediate doses: cell proliferation, growth factor release, apoptosis in cancers, etc.

- consists of ions, electrons, neutral species (atoms, molecules)
- exhibits collective effects (waves, ...)
- interacts with electric and magnetic fields

Possible effects on organisms

- reactive oxygen and nitrogen species (RONS)
- UV photons
- electric fields
- charged particles (ions, electrons)
- synergy of all four phenomena.







High doses: normal cell death. Very high doses: necrosis.

D. Dobrynin et al, New Journal of Physics **11**, 115020 (2009)

Planar RF antenna resonant networks

Prototypes of Helyssen antennas operating at 13.56 MHz have been tested up to 15 kW rf power and are currently under industrial pilot tests for barrier layer coatings in packaging, silicon thin film deposition for photovoltaic solar cells, and plasma sources for neutral beam heating. Conventional plasma sources operate at low pressures (< 10 mbar) which require long exposure times (20 minutes) for spore inactivation.

Conclusions

Alive .

These results show the proof of principle of a novel generic type of plasma source. The next step is to develop the source towards higher operating pressures for rapid inactivation of spores, and integration into

The planar antenna is for large area surface treatment; the cylindrical antenna is for volumetric plasma sources. The parallel legs of each antenna are made of copper tubes which act as inductances. High Q capacitors link the legs together. High currents circulate in the resonant structure which is an efficient inductively-coupled plasma source.

fluidized bed reactors for food powder manipulation and treatment.

Acknowledgments

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