1st World Congress on Electroporation and Pulsed Electric Fields in Biology, Medicine and Food & Environmental Technologies

incorporating

BFE2015 - The 3rd International Bio & Food Electrotechnologies Symposium

and

Bioelectrics 2015 - The 12th International Bioelectrics Symposium

Portorož, Slovenija
September 6 to 10, 2015

University *of Ljubljana*
Faculty *of Electrical Engineering*

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in the field of dermatology, wound healing, veterinary medicine and dentistry. The investigation of selected biological effects will be shown. It will be demonstrated that the combined research in physics and life sciences is fundament for a successful transfer of plasma medicine from laboratory to clinics.

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Mon-D2-O5

Antibacterial Efficacy of a Novel Plasma Reactor without an Applied Gas Flow

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The use of nonthermal plasma in the clinic has gained recent interest, as the need for alternative or supplementary strategies are necessary for preventing multi-drug resistant infections. The purpose of this study was to evaluate the antibacterial efficacy of a novel plasma reactor based on a high current version of sliding discharge and operated by nanosecond voltage pulses without an applied gas flow. This modification is advantageous for both portability and convenience. Bacterial inactivation was determined by direct quantification of colony forming units. The plasma was bactericidal against Escherichia coli and Staphylococcus epidermidis seeded on culture media. Plasma exposure significantly inhibited the growth of both model organisms following a 1-minute application ($p<0.001$). Results indicate that S. epidermidis was more susceptible to the plasma after a 5-minute exposure, compared to E. coli. Temperature measurements taken immediately before and after plasma exposure determined that heat does not play a role in bacterial inactivation. These findings suggest the current plasma has potential application for surface bacterial decontamination.

Mon-D2-O6

Chemistry of Plasma-Liquid Interactions Related with Biocidal Effects of Non-Thermal Plasmas in Gas-Liquid Environments

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Different types of non-equilibrium atmospheric pressure plasmas (NTAPs) generated by electrical discharges in gases and liquids have been applied for biological and medical applications. NTAPs have been shown to be effective in inactivation of wide range of microbes, and have been also applied directly to the human body for the treatment of skin diseases and dental cavities, and other applications. Depending on the type of discharge, its energy, and the chemical composition of the surrounding environment various physical and chemical processes may be involved in the biological effects induced by NTAPs. These include thermal, electric field, ultraviolet radiation, shock waves, direct chemical reactions of neutral reactive species, and interactions of charged particles with living matter. Among these processes, the oxidative properties of reactive oxygen species (OH radical, atomic oxygen, ozone, hydrogen peroxide) and nitrogen species (nitric oxide, nitrogen dioxide radical) are generally accepted to play central role in the inactivation processes of NTAPs produced in gas-liquid environments - typically discharges produced in humid air touching a wet surface (biofilms, cell tissue, skin) or an aqueous liquid. There are also possible synergistic effects of the above mentioned processes and secondary chemical and biological effects can be induced in the plasma-treated liquid through the post-discharge reactions of chemical species produced by plasma in the liquid either directly, or transferred from the gas phase discharge plasma via gas-liquid interface (e.g., H2O2, ozone, nitrite, peroxynitrite). Important roles of these species in biological effects are acknowledged, however, the mechanisms and contributions of these species are not fully understood because the complexity of both the plasma and biological systems. In this talk fundamental issues related with the chemistry of plasma liquid interactions will be discussed with special attention to the peroxynitrite chemistry in plasma treated liquids and its role in biocidal effects of air discharge plasmas.

Mon-D2-O7

Chemistry and biodecontamination induced in water electrosprayed through air plasma discharge

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Decontamination of water polluted with organic and mic bial pollutants, and biomedical effects on cells and biomolecu mediated through aqueous solutions can be efficiently achiev by using various non-thermal (cold) plasma discharges. These fects can be further enhanced when air discharges are combi with water electrospray. The presence of the electrical discha in the spraying area allows for very efficient mass transfe plasma-generated species into the water.

We investigated the effect of the electrospraying of wate combination with positive DC corona and transient spark charges. Our key finding is that the discharge has a signific effect on the electrospray behavior and vice versa. Such w electrospray-air discharge systems were demonstrated to be efficient in inducing bactericidal, sporicidal, and various chem effects in the plasma activated water, especially acidification formation of hydrogen peroxide and nitrites that subseque lead to cytotoxic peroxynitrites. [1-5]

This work was supported by Slovak Research and Deve ment Agency APVV-0134-12 and COST Action TD1208 – trical Discharges with Liquids for Future Applications.

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Mon-D2-O8

Use of High Voltage Atmospheric Cold Plasm Food Preservation and Food Processing

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It is estimated between 30-40% of all harvested food from spoilage in developing countries due to a lack of pre tion methods such as canning, freezing, and refrigeration rent use of synthetic chemicals to reduce or prevent po vest food losses is diminishing because of possible carcin and teratogenic effects, high residual toxicity, potential e mental pollution, and concerns regarding their health eff consumers. A potential alternative technology for reduci spoilage is high voltage atmospheric cold plasma (HVACP ment. The HVACP technology was developed by Dr. Ke Purdue University and allows one to significantly reduce some instances, sterilize food products. The HVACP is a atmospheric cold plasma that utilizes low frequency (50 and high voltage (30 – 130 kV). The HVACP technol be applied to packaged food products (plastic bags, pap rigid plastic containers) and potentially bulk agricultur ucts stored in totes, shipping containers, and bins. The technology only requires air within the packaged foo