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PROGRAM BOOK

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Title

Decontamination of *Bacillus cereus* Spores and *Streptococci* Biofilms on Plastic Surfaces with DC and Pulsed Corona Discharges

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Abstract (500 words maxi)

Biological decontamination of thermo-sensitive plastic materials used in medicine or in food packaging, from bacterial spores, biofilms, and other resistant microbial pathogens represents a technological challenge. We applied non-thermal (cold) air plasmas generated by DC and pulsed corona discharges - positive streamers and negative Trichel pulses - and tested them for eradication of *Bacillus cereus* spores and *Streptococci* biofilm on polypropylene plastic surfaces. The results show that both polarities of DC and pulsed coronas can reduce the spore or bacterial population in the biofilm up to 2-3 logs in 10 min exposure time. No significant polarity effect was found with DC corona. Pulsed corona was demonstrated slightly more bactericidal for spores, especially in the negative polarity. [1] The 3-log bactericidal effect can be reached faster (within 2 min) when applying electrostatic spraying of water through the discharge [2] onto the treated spore/biofilm contaminated surfaces. We attribute this significant enhancement of plasma combined with electrospraying of water to the enhancement of the mass transfer of the air plasma generated reactive oxygen and nitrogen species ($OH^{\bullet}$, H_2O_2, $O_2^{-\bullet}$, O_3, NO_x) into water inducing chemical changes in water related to strong biocidal effects [3]. The same air plasma discharges were demonstrated to efficiently inactivate oral biofilms grown on teeth without any damaging effect of tooth surface composition and structure, which represent new potential application in dentistry [4].

Fig. 1. The positive streamer corona discharge over a polypropylene surface contaminated by spores. U = 6 kV, f = 15 kHz, I_{max} = 100 mA.

Acknowledgement

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References

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Short CV (150 words maxi) for invited speakers only

Dr. Zdenko Machala is an associate professor in physics at Faculty of Mathematics, Physics and Informatics, Comenius University, Bratislava, Slovakia. His research expertise is in physics of low temperature plasmas and electrical discharges, their advanced electrical and optical diagnostics, their biomedical and environmental applications, and related plasma chemistry in gases and liquids interacting with plasmas. In the recent years he focused especially at biomedical applications of cold air plasmas, especially at water and surface bio-decontamination and fundamental understanding of plasma-liquid-cell interactions.

In his scientific career he established many international research collaborations: starting with his dual PhD. (2000, Université Paris XI, France – 2001, Comenius University, Slovakia), through his post-doc (2002-04, Stanford University, USA), several invited and visiting professorships (2004 and 2011 Ecole Centrale Paris, France; 2013 University of California Berkeley, USA), and many short visits and bilateral projects. He has been a principal investigator or vice-PI of several international and many national research projects. He is the author of >30 research papers, >100 conference contributions, 2 book chapters, and a book editor (*Plasma for bio-decontamination, medicine and food security*, NATO Science for Peace and Security Series, Springer 2012). He gave >13 invited lectures and seminars at interational conferences and workshops and is very active in the plasma community in several interantional committes and boards (International Plasma Chemistry Society, International Society for Plasma Medicine, International Conference on Phenomena in Ionized Gases, COST TD1208 Electrical Discharges in Liquids for Future Applications, COST MP1101 Bioplasma, etc.).