SYPP 2: Pulsed Power für Medizin und Biotechnologie II

Zeit: Donnerstag 14:00–16:00 Raum: HS 3

Hauptvortrag SYPP 2.1 Do 14:00 HS 3

Pulsed Electric Fields for the Manipulation of Cancer Cells — Anna Steuer, Fukun Shi, Christina M. Wolff, and •Juergen F. Kolb — Leibniz Institute for Plasma Science and Technology, Greifswald

Pulsed electric fields with durations of nanoseconds and strengths on the order of tens of kilovolts per centimetre have been developed as an alternative method to induce cell death in cancer cells by apoptosis. Following many successful experiments with animals, currently also clinical studies are devised. Basic research on the underlying mechanisms has mostly focused on the study of individual cells in suspension. However, for cells that are organized in a tissue, connections and communication between cells are crucial. Accordingly, we investigated besides intracellular effects also extracellular effects and in particular the response on tight junctions and cell-cell communication and how both affect the development of cells in a tissue, such as their potential to metastasize. Distinct effects could be found that are primarily caused by a transient disassembly of respective membrane proteins that are only compensated by repair mechanisms over the course of one hour. Conversely, these changes have an immediate effect on intracellular biomolecular pathways, elastic properties of cells and on the permeability of tissues. Some of these effects can be enhanced by combining the treatment with pulsed electric fields and exposures to non-thermal plasmas. Overall this allows for new possibilities for tumour treatment and potentially also tissue regeneration.

Hauptvortrag SYPP 2.2 Do 14:30 HS 3

Pulsed electric field use in food industry - process and equipment design — Robin Ostermeier, Julian Witt, and •Stefan Töpfl — Elea GmbH, Prof.-von-Klitzing-Str. 9, D-49610 Quakenbrück, Germany

Application of Pulsed Electric Fields (PEF) results in permeabilization of plant, animal and microbial cells. This allows acceleration of mass transport processes such as drying or extraction as well as improving cutting properties. For liquid media a low heat microbial decontamination can be achieved. The talk will present selected application examples of PEF in industrial use and their commercial, technical and legislative framework.

Hauptvortrag SYPP 2.3 Do 15:00 HS 3

Pulse Generators for a Scale-Up of an Electroporation Device for Mash — •Martin Sack[1], Martin Kern[2], Hermann Armbruster[3], Johannes Fleig[1], Dennis Herzog[1], Martin Hochberg[1], and Georg Mueller[1] — [1]Karlsruhe Institute of Technology, Hermann-von-Helmholtz-Platz 1, 76344 Eggenstein-Leopoldshafen, Germany — [2]KEA-TEC GmbH, Kaigartenallee 8, 68753 Waghäusel, Germany — [3]Armbruster Kelterei-Technologie GmbH, Zu den Weiherwiesen 1-3, 74363 Güglingen, Germany

For a scale-up of an electroporation device for mash an existing design for a Marx generator equipped with spark gap switches has been improved to allow for a higher pulse repetition rate and a synchronized operation of two Marx generators charged by a single high-voltage power supply. As the pulse repetition rate of spark gap switches is limited due to the time required to remove charged particles and debris from the inter-electrode area, each spark gap has been equipped with a nozzle to guide the gas towards the gap and, hence, increase the gas flow between the electrodes. A pulse repetition rate of 38 Hz has been achieved. Synchronized operation of Marx generators feeding one electroporation chamber enables to overcome limitations in power due to the circuit inductance. A trigger circuit to trigger the generators by overvolting the first spark gap has been set up and tested successfully. In the talk selected design details and results will be presented.

Hauptvortrag SYPP 2.4 Do 15:30 HS 3

Spark discharges as tool for the extraction of microalgal compounds — •Katja Zocher, Raphael Rataj, Anna Steuer, and Juergen F Kolb — Leibniz Institute for Plasma Science and Technology, Felix-Hausdorff-Straße 2, 17489 Greifswald, Germany

Microalgae have gained in importance for green biotechnology during the last years. Besides their potential as feedstock for alternative renewable energy resources, they also contain valuable metabolites for pharmaceutical and nutritional applications, such as lipids, proteins, polysaccharides, and pigments.Although only frugal cultivation conditions are necessary, microalgae are distinguished by a robust cell wall, which allows a remarkable mechanical and chemical robustness. This characteristic often results in poor extraction yields. Conventional extraction techniques have shown to be therefore frequently energy and time consuming, which causes disproportional economic costs. Accordingly, major improvements of extraction technologies are necessary for successful commercialisation. In previous works [1][2], we could show that spark discharges, instigated directly in the microalgae suspension by 100-ns high voltage pulses, offer a gentle and yet effective approach. In comparison to a selected reference method, proteomic analysis revealed commonalities and differences in the protein distribution pattern, although the number of extracted proteins was the same and, in particular, valuable heat sensitive compounds could be extracted. Schlieren diagnostics and atomic forced microscopy was applied to elucidate the responsible spark characteristic for successful cell wall rupture. [1-2] Zocher, K. et al., 2016 and 2018 (under review)