SYPP 1: Pulsed Power für Medizin und Biotechnologie I

Zeit: Donnerstag 11:00–12:45 Raum: HS 3

SYPP 1.1 Do 11:00 HS 3

Pulsed Power Yesterday, Today and Tomorrow — •Andreas Görtler[1] and Juergen Kolb[2] — [1]Gymnasium Wertingen, Pestalozzistraße 12, 86637 Wertingen — [2]Leibniz Institute for Plasma Science and Technology, Felix-Hausdorff-Str. 2, 17489 Greifswald

Pulsed Power is primarily an enabling technology. Continuous development of devices and respective know-how has always motivated and initiated novel approaches and concepts, often in fields that were not readily anticipated. This is seen in particular for applications in medicine and biotechnology but also other areas. Examples are excimer lasers and plasmas in general that are generated by pulsed discharges and are for example used for decontamination of air and water but also for the synthesis of nanomaterials. Pulsed electric field treatments have instigated new medical therapies especially for tumor therapies but have also been successfully introduced in the processing of food crops, e.g. potatoes and wine. Other emerging applications are found for the generation of biofuels or the extraction of valuable compounds from algae. This special session is giving an overview on possibilities and recent advances for applications that rely on Pulsed Power technologies.

Hauptvortrag SYPP 1.2 Do 11:15 HS 3

30 years of Pulsed Power in medical Excimer laser — •Claus Strowitzki — MLase AG

This paper gives an overview of the development of pulsed power in medical excimer lasers. Pulsed power in medical excimer lasers is quite challenging. The load is a discharge; this means the impedance changes from open to virtually a short circuit in some ns. Hence a matching of the pulsed power module to the load is not possible. In the last 30 years 3 development big steps were made. First circuits work with a Thyratron. These circuits were quite simple, but suffer from low lifetime. About 50 % of the energy is reflected by the discharge. The reflected Energy produces oscillation in the circuit. The next step was the replacement of the Thyratron by a Thyristor. Due to the lower voltage and switching capability, the voltage has to be raised by a pulse transformer and the pulse has to be compressed by magnetic pulse compression (usually 3 stages). IGBT modules became more powerful and enable faster switching than Thyristors. Hence, the pulse compression network became smaller (only 2 compression stages) and due to a blocking diode together with an energy recovery circuit, reflected energy could be restored. These modules avoid oscillating and enable excellent live time. The live time of the laser is also extended because total charge through the discharge is reduced. This is the current state of the art. Current development is a new circuit topology based on a full bridge primary switch configuration. These circuits have smaller part count and uses standard phase legs IGBT modules. They are especially suited for high repetition rate operation (above one kHz).

Hauptvortrag SYPP 1.3 Do 11:45 HS 3

Frontiers of Electroporation, from Mechanisms to Applications: Unraveling new key molecular level aspects using computational chemistry — •Mounir Tarek — Centre National de La Recherche Scientifique (CNRS), Université de Lorraine, Nancy, France

The application of short and intense electric pulses enables to transiently alter the properties of cell membranes, making them permeable to a wide range of chemical species. This phenomenon is routinely used in a range of medical applications as well in biotechnology and industrial processing. Few years ago, pioneering MD simulations have been conducted in order to model the effect of electric fields on membranes, providing perhaps the first molecular model of the electroporation process of lipid bilayers. Our knowledge however about all occurring processes is still sketchy. In this contribution we show how we harness the capabilities of computational resources and the predictive power of advanced atomistic and quantum level molecular dynamics techniques to decipher key steps in several physical and biophysical and chemical processes occurring at the cell membranes when these are subject to electric pulses used in Electroporation Based Technologies and Treatments.

Hauptvortrag SYPP 1.4 Do 12:15 HS 3

Calcium electroporation - a novel, low-cost anti-cancer treatment — •Stine Krog Frandsen[1] and Julie Gehl[1,2] — [1]Department of Clinical Oncology and Palliative Care, Zealand University Hospital, Roskilde, Denmark — [2]Department of Clinical Medicine, University of Copenhagen, Denmark

Calcium electroporation is a potential novel anti-cancer treatment where supraphysiological calcium concentrations are introduced into cells by electroporation, a method where short, high voltage pulses induce a transient permeabilisation of the plasma membrane allowing passage of ions and molecules into the cytosol. Calcium electroporation efficiently induce cell death in vitro and tumor necrosis in vivo (1). The first clinical trial showed that calcium electroporation is efficient on cutaneous metastases (2). The mechanism is associated with ATP depletion, and normal cells are less affected than malignant cells in vitro and in vivo (1). This difference in sensitivity might be due to differences in the expression of calcium transporters and differences in the cytoskeleton organization. Interestingly, it has recently been shown that calcium electroporation induces a systemic response in vivo (3) and in the clinical trial (4). Calcium electroporation is an efficient and simple, novel anti-cancer treatment that can easily be implement in the clinic. Recent studies indicate that this local treatment also induces a systemic immune response.

1. Frandsen, et al. Cancer Res. 2017. 2. Falk, et al. Acta Oncol. 2017. 3. Falk, et al. Oncoimmunology. 2017. 4. Falk, et al. Acta Oncol. 2017.