SYPT 2: Application and New Trends of Plasmatechnology - Part II

Time: Thursday 14:00–16:00 Location: M 00.910

Invited Talk SYPT 2.1 Thu 14:00 M 00.910

Plasmaphysical Basics of Vacuum Switching Devices for High Currents and Voltages — •Norbert Wenzel — Siemens AG, Corporate Technology Research In Energy and Electronics Switching and Power Grid, Günther-Scharowsky-Str. 1 91058 Erlangen

The technology of vacuum arc plasmas is being applied successfully to the development of high-current and high-voltage switching devices. Advances in the design of vacuum interrupters have been accompanied by a deeper understanding of the physical processes in the arc column and in the arc attachment zone on the cathode that comprises the cathode spots feeding the arc with metal vapor. This contribution starts with an introduction to the spatiotemporal characteristics of a vacuum arc during short-circuit current breaking. It describes methods to control the arc by magnetic fields forcing the arc to burn in a diffuse or a rotating constricted mode in order to distribute the energetic stress of the arc homogeneously over the contact surface. It reports on experiments with high-speed video cameras and fast magnetic probes. And it presents a physical model of the plasma together with numerical simulation results. The combination of experimental and theoretical studies delivers quantitative key parameters of the arc under practical operation conditions and thus allows a purposeful improvement of the performance of industrial high-power circuit breakers. The contribution concludes with challenging switching applications in vacuum: a generator circuit breaker ($>$ 70kA) and a large-gap interrupter operated at high voltages ($>$ 72kV).

Invited Talk SYPT 2.2 Thu 14:30 M 00.910

Discharge inception and breakdown in weakly and strongly electronegative gas in HV switchgear applications — •Martin Seeger — Senior principal scientist ABB Schweiz AG RD-P1 Segelhofstrasse 1K 5405, Baden-Dättwil, Aargau, SWITZERLAND

The control of gaseous insulation capability in HV switchgear and insulation applications is important for reliable operation of HV transmission and distribution systems. This is not only important for gaseous insulation at ambient temperatures (e.g. 300 K) but also for the insulation at elevated temperatures as they occur for example in HV circuit breakers (e.g. up to 3000 K) and switches after switching operations. Typically HV switchgear and insulation systems are operated at pressures in the range of 100 kPa to 1 MPa, which defines the main pressure range of interest. The present paper will addresses the most important physical processes, like streamer and leader transition for discharge inception and breakdown on the example of weakly and strongly electronegative gases, like CO2 and SF6, respectively. An overview of experimental investigations and simple predictive models will be given.

Invited Talk SYPT 2.3 Thu 15:00 M 00.910

Plasma Technological Research for Electrical Engineering and Medicine — •Dirk Uhrlandt — INP Greifswald Felix-Hausdorff-Str. 2 17489 Greifswald

The Leibniz Institute for Plasma Research and Technology (INP) in Greifswald carries out application oriented and fundamental research in a broad area from materials and technologies for renewable energy and resource-efficiency up to applications in medicine and hygiene. The potential of current research will be illustrated by means of two examples: The deeper understanding of arcs and other discharges in power distribution systems supports new solution approaches for the challenges of the German Energiewende. Use of environmentally friendly materials and energy efficient solutions for the mobility sector and the long-distance power transfer are in the focus. Recent developments in the technology of cold atmospheric pressure plasma sources enable a variety of new applications in life science e.g. therapeutic treatment of chronic wounds in human and veterinary medicine. This becomes possible by the strongly interdisciplinary research from the detailed diagnostics of plasma sources, the explanation of the plasma-chemical, biochemical and cell-biological mechanisms up to the responsible clinical trials. The strategy to carry out interdisciplinary and transdisciplinary research under one roof has led to meanwhile four spin off companies in the fields of diagnostics and plasma medicine and surface modification.

Invited Talk SYPT 2.4 Thu 15:30 M 00.910

Progress in Understanding Arc-Electrode Interaction — •Jürgen Mentel — Ruhr-University Bochum, Electrical Engineering and Plasma Technology, 44780 Bochum, Germany

Within the last years a model of a microscopically thin boundary layer covering the cathode surface was developed managing the current transfer between arc plasma and cathode. An extremely high local electrical power input into the layer effects that the local power- and current-transfer from the arc plasma to the cathode surface are only determined by the local electrode surface temperature and the global cathode fall so that the solution of the cathodic power balance is decoupled from the bulk plasma. For a given arc current generally several solutions are found: always a diffuse mode and mostly several spot modes of arc attachment. The properties of the diffuse mode and of low voltage spot mode are confirmed by measurements at tungsten electrodes. The arc attachment at anodes is determined by the mass flow in front of it and on the anode temperature. In front of cold anodes an electric field reversal and arc constriction occurs, which may need being stabilized by a mass flow. In front of hot, electron emitting anodes the field reversal disappears and the arc attachment becomes diffuse and stable.