P 4 Hauptvortrag (Th. Hammer)

Zeit: Freitag 14:00–14:45 Raum: HU 3038

Hauptvortrag

P 4.1 Fr 14:00 HU 3038

Plasmakatalytische Prozesse bei Atmosphärendruck — •Thomas Hammer und Thomas Kappes — Siemens AG, Corporate Technology Department CT PS 5, Paul-Gossen-Str. 100, 91052 Erlangen

Katalytische Reaktionen können in einem Gasgemisch durch Vorbehandlung mit einem Gasentladungsplasma (2-stufiger Reaktor) oder durch kombinierte Behandlung in einem Plasma-katalytischen Hybridreaktor (1-stufiger Reaktor) induziert werden. Als zugrunde liegende Prozesse kommen Anregung von Molekülen, Bildung langlebiger Zwischenzustände, UV-Emission oder Temperaturerhöhung in Frage. Die Anwendbarkeit der zwei Reaktorkonzepte wurde anhand der Dieselabgasreinigung und der Methan-Reformierung demonstriert: Durch die Vorbehandlung von Dieselabgas mit dielektrisch behinderten Entladungen wurde selektive katalytische NOx-Reduktion > 50 % bereits bei 100 °C statt bei 200 °C erzielt. Wegen der niedrigen spezifischen Plasma-Energiedichte von rund 10 J/Liter Abgas spielt Gasaufheizung hier keine Rolle. Plasmakatalytische Dampfreformierung von Methan wurde in einem dielektrischen Festbettreaktor bei Temperaturen bis zu 200 °C hinunter durchgeführt. Aufgrund der hohen spezifischen Plasma-Energiedichte von über 1 kJ/Liter spielten sowohl nicht-thermische Effekte als auch die Gasaufheizung durch das Gasentladungsplasma eine Rolle. Modelle der plasmachemischen Kinetik wurden entwickelt.

P 5 Niedertemperaturplasmen / Plasmatechnologie 2

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P 5.1 Fr 14:45 HU 3038

Ionization fronts in a system with the high-ohmic electrode — •Shalva Amiranashvili, Svetlana Gurevich, and Hans-Georg Purwins — Institut für Angewandte Physik, Westfälische Wilhelms-Universität

Electrical breakdown and ionization fronts are considered in a sandwich-like discharge system consisting of two plane-parallel electrodes and a gaseous gap in between. The key system feature is a high-ohmic cathode opposed by an ordinary metal anode. Using two-scale expansion we demonstrate that in the low-current Townsend mode the discharge is governed by a two-component reaction-diffusion system. The latter quantities the system on the time scale that is much larger than the ion drift time. The breakdown appears as an instability of the uniform overvoltage state. A seed current fluctuation develops in a shock-like ionization front that propagates along the electrodes. The front is essentially nonlinear and spreads with the constant velocity, the latter is uniquely determined by system parameters and can be compared with experimental data. Depending on the cathode resistivity the front is either monotonic or oscillatory. Other breakdown features, such as current oscillations, are also traced.

P 5.2 Fr 15:00 HU 3038

Thermal Interruption Performance of High-Voltage Circuit Breakers — •Christian M. Franck, Alexander Steffens, and Martin Seeger — ABB Schweiz AG, Corporate Research, Segelhof, CH-5405 Baden-Dättwil

Circuit breakers are the key component to ensure reliability and security of present power transmission and distribution systems. Modern high-voltage ($U_r > 72$ kV) circuit breakers are rated to interrupt short-circuit currents up to 80 kA_{rms} and ABB's latest generator circuit breaker even up to 200 kA_{rms} ($U_r = 30kV$). They consist basically of a mechanically operated metal contact system with an arc quenching chamber to extinguish the switching arc that is ignited during opening. The thermal interruption capability of a HV circuit breaker is determined by the maximum voltage steepness applicable without any time delay after breaking at current zero of a large fault current. New breaker designs are routinely tested experimentally for their thermal interruption performance in synthetic circuits in high-power laboratories. The installation, maintenance and operation of these labs and the performance of the tests are extrememly cost and labour intensive processes. Modern CFD (Computational Fluid Dynamics) tools are thus increasingly used to understand the interruption capability of high-voltage circuit breakers. With such a tool, developed and validated at ABB Corporate Research, a systematic study of the influence of the gas blow pressure and the nozzle geometry on the thermal interruption capability was done. Latest results of both, experimental tests and numerical simulations of the thermal interruption performance of HV circuit breakers are shown and compared.

P 5.3 Fr 15:15 HU 3038

Intensive excimer emission from nanoseconds pulsed micro hollow cathode discharges — •Byung-Joon Lee, Isfried Petzenhauser, and Klaus Frank — Physics Department 1. University of Erlangen-Nuremberg, Erwin-Rommel Straße 1, 91058 Erlangen

Micro hollow cathode discharges (MHCDs) which have dimensions in the range of 100 μm are high pressure, nonequilibrium discharges. Recently, MHCDs are intensively investigated as a VUV emission source in rare gases. Operating in pulsed mode (pulse duration on the order of 1 to 100 μs), the relative efficiency of the xenon excimer emission reveals an inverse dependence on the pulsed lengths. Therefore in our experiment we reduced pulse width down to nanoseconds ranges in order to increase efficiency of excimer emission in xenon (172 nm). To produce a nanoseconds ranges pulse, a self-matched transmission line pulse generator capable of producing a single high voltage output with minimised reflections regardless of the load impedance is introduced. Changing pulse width (20 ns, 50 ns and 100 ns respectively) and gas pressure, the relative efficiency of the excimer emission in the superimposed(dc+ nanoseconds pulsed) mode and pulsed mode will compared. In addition, the temporal behaviour of the excimer emission from cathode side and anode side will be discussed.

P 5.4 Fr 15:30 HU 3038

Space charge potential in the molecular gaseous tritium source plasma of the KATRIN experiment — •Ferenc Glück (for the KATRIN Collaboration) — Forschungszentrum Karlsruhe, Institut f. Kernphysik

The aim of the KATRIN experiment is to determine the absolute value of the neutrino mass down to 0.2 eV, by measuring the integral energy spectrum of the electrons created by beta decay of T_2 molecules. The gaseous tritium source is planned to have 27 K temperature in a 10 m long and 9 cm diameter tube, and in a 3.6 T axial magnetic field. About 2×10^{12}/s positive ion — secondary electron pairs are created in the source due to beta decay and ionization processes. The charged particles can leave the source tube by gas flow and diffusion (in a time-scale of 1 s), and in addition they can be destroyed by electron-ion volume recombination. The plasma density is a few times 10^6 e/cm^3. The cooling of the secondary electrons is determined mainly by inelastic, elastic and superelastic collisions with the gas molecules. Our Monte Carlo calculations show that the electron distribution function has a large peak at 2.5 meV. The space charge potential is expected to be smaller than 20 mV, which corresponds to a negligible systematic effect for the neutrino mass determination.

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