Title: The Role of Surface Charges in Plasma Catalysis

Sector of research: Physics

Degree awarded: Dr. rer. nat.

Keywords: Plasma catalysis, laser, absorption spectroscopy, modelling

Supervisor of PhD project:
Jun.-Prof. Dr. Judith Golda, Group leader of Research Group for Plasma Interface Physics, Faculty for Physics and Astronomy, Judith.Golda@rub.de, ORCID: 0000-0003-2344-2146

Research focus of supervisor:
Prof. Golda’s research focuses on the interaction between plasmas and materials with an emphasis on atmospheric pressure plasmas. The research group uses and develops in-situ diagnostic techniques, in particular electrical measurements, emission spectroscopy and laser absorption spectroscopy. This is complemented by simple models to interpret and extrapolate experimental results. By combining various diagnostic techniques, fundamental processes at the plasma-surface boundary are investigated and entangled. Prof. Golda is involved in the Collaborative Research Center 1316 and a principal investigator in three different sub-projects dealing with catalytic surfaces for electrolysis, bio-catalysis and plasma catalysis of volatile compounds.

Publications: 17 publications, h-Index 9


Second Supervisor of PhD project

Prof. Dr. Achim von Keudell, Chair for Experimental Physics II “Reactive Plasmas”, Faculty for Physics and Astronomy

**Summary of research plan:**

**Background:** Plasma catalysis is an emerging technology for the production of solar fuels which are part of the strategy to store renewable energy. In contrast to conventional thermal catalysis, a plasma is used in combination with new catalyst materials to enhance selectivity, efficiency and conversion rate. However, the complexity of this seemingly simple concept is enormous due to the high number of various species produced in a plasma. Surface reactions are at the heart of plasma catalysis, in particular surface charges are predicted to play a significant role. For any rational tuning of theses processes, a fundamental understanding of the involved plasma-catalyst surface interaction is required.

**Study objective:** In this project, we will use atmospheric pressure microcavity arrays to investigate the influence of charged species deposited on dielectrics on the plasma chemistry. Therefore, we will build a setup for laser photo desorption diagnostics to measure and control the surface charges in-situ during the plasma catalysis process. In combination with a mass spectrometer, we can investigate the influence on actual plasma catalysis reactions. This will be complemented by simulating reactive species in the plasma in collaboration with partners in the engineering department of RUB.

**Expected Results:** Using the technique described above, we will be able to quantify the influence of surface charges on the conversion of volatile organic compounds such as n-butane. This will allow to identify any plasma surface synergisms. The work will result in papers led by the candidate: A technical publication summarizing the diagnostics and its limits and at least a second publication presenting the scientific results.

**Methods:** The candidate will be trained to perform emission spectroscopy, laser charge ablation, and electrical measurements. All infrastructure is available. The work will be performed within the CRC 1316 collaboration, which includes regular presentation in the working groups and on international conferences.

**Candidate Requirements:** MSc degree in physics is mandatory. Methodological expertise in experimental physics is preferred. Expertise in data analysis and a programming language such as python is strongly desired, Good English language skills are essential. Soft skills and good communication is required to work successfully in our motivated, dynamic and interdisciplinary team.

**Motivation for CSC application:** A broad scientific skill set will be taught that covers various aspects of experimental plasma diagnostics as well as fundamental plasma simulation techniques. The project is integrated in the Coordinated Research Centre 1316 (www.sfb1316.rub.de), where 23 PIs and 30 PhD students work together on transient atmospheric plasmas for novel methods of energy conversion. This CRC also operates an integrated training programme. Furthermore, the project will be embedded in the Ruhr-University Research School (http://www.research-school.rub.de/), which offers additional soft-skill seminars, tutoring, and career development.