International Low Temperature Plasma Community

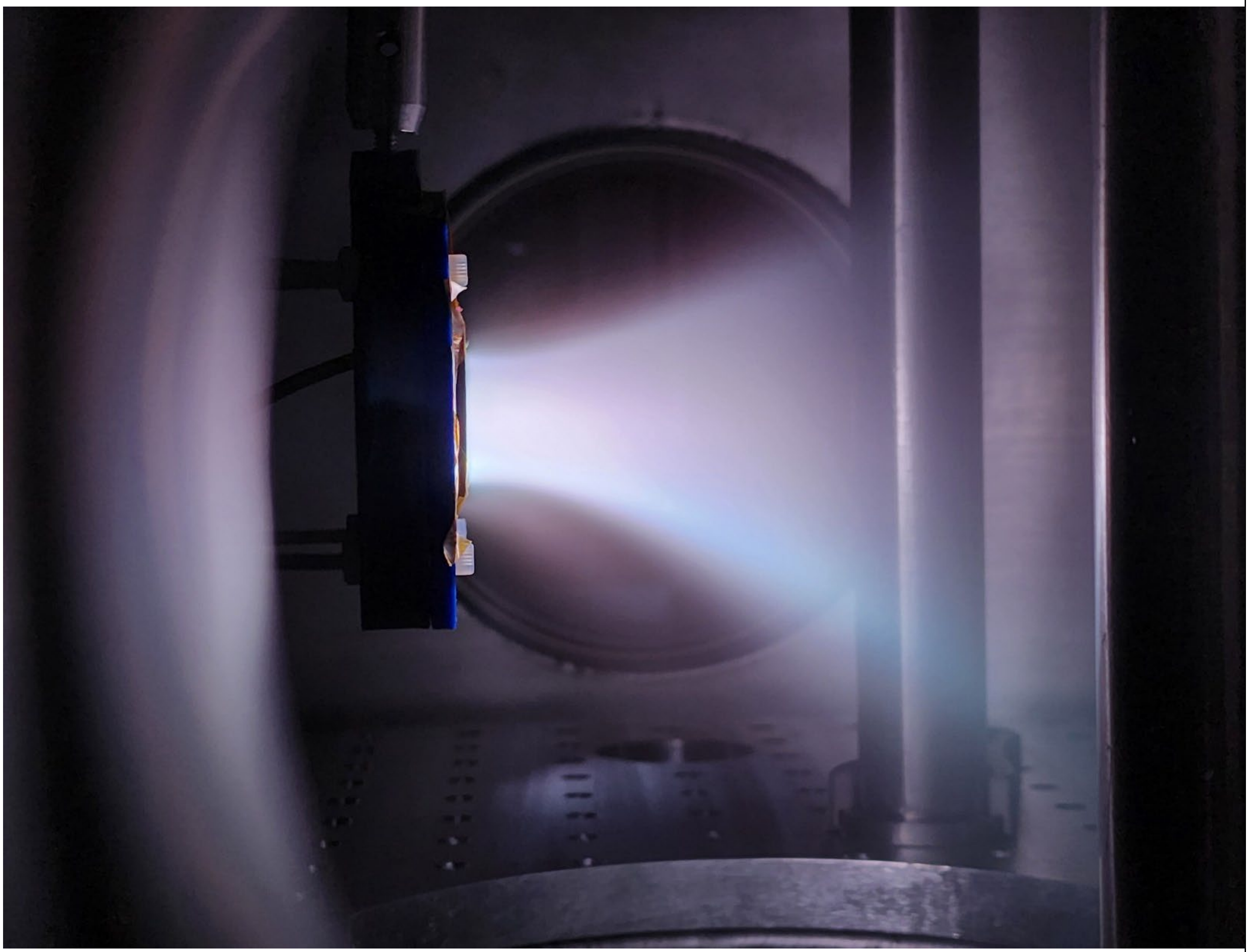
https://mipse.umich.edu/iltpc.php, iltpc-central@umich.edu

Newsletter 31

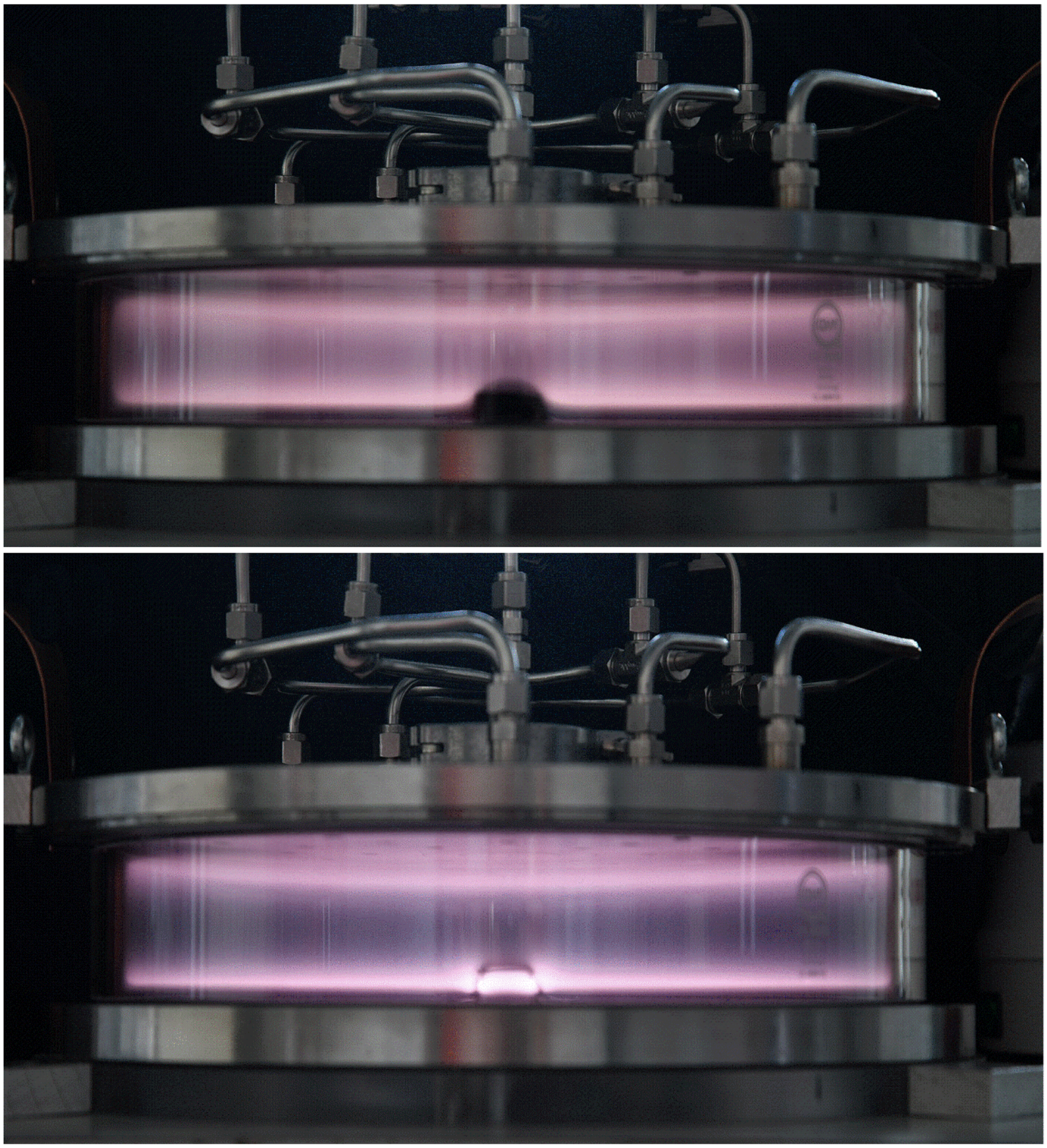
12 April 2023

Images to Excite and Inspire!

Please send your images (with a short description) to iltpc-central@umich.edu. The recommended image format is TIF, JPG, or PNG. The minimum file width is 800 px.



Miniature electric propulsion thrusters: The image shows a helium plasma generated with a concentric split-ring resonator (CSRR) at low vacuum. The CSRR consists of a pair of concentric rings with a split in each that are fabricated with wet etching techniques on a Rogers Duroid substrate. The expanding plume is caused by the addition of a pair of strong ring-shaped permanent magnets behind the CSRR (to the left of the glow). The image was taken at Sandia National Laboratory where laser collisional-induced fluorescence was being used to characterize the plasma in 3D. The permanent magnet CSRR is being studied for use in miniature electric propulsion thrusters. **Prof. Gabe Xu,** University of Alabama-Huntsville, gabe.xu@uah.edu.



Crossing the Debye Length boundary in a low-pressure RF plasma reactor - a simple demonstration: The Debye length is an important parameter of plasmas and indicates at which length their charge carriers are shielded. A tunnel made of black PET with holes (10 x 4mm diameter) at both lateral sites to allow gas diffusion is introduced inside a parallel-plate capacitively coupled plasma reactor (diameter 30 cm, distance between electrodes 9 cm). An argon (20 sccm) discharge is ignited by radiofrequency excitation at low pressure. Simply varying the gas pressure between (top) 7 and (bottom) 20 Pa modifies the Debye Length. This avoids ignition of the discharge inside the tunnel at the lower pressure due to increased electron temperature T_e and lower electron density n_e, thus resulting in a larger Debye length. Increasing pressure results in a decreasing Debye length due to lowering T_e and increasing n_e, enabling plasma ignition inside the tunnel. In both cases, the plastic tunnel alters the symmetry of the discharge, with lower plasma intensity on top of the tunnel due to the changes in the electron density in this region (lack of repelled electrons). **Dr. Paula Navascués** (paula.denavascues@empa.ch), **Dr. Martin Amberg** (martin.amberg@empa.ch), and **Dr. Dirk Hegemann** (dirk.hegemann@empa.ch). Plasma & Coating Group, Empa (St. Gallen), Switzerland.

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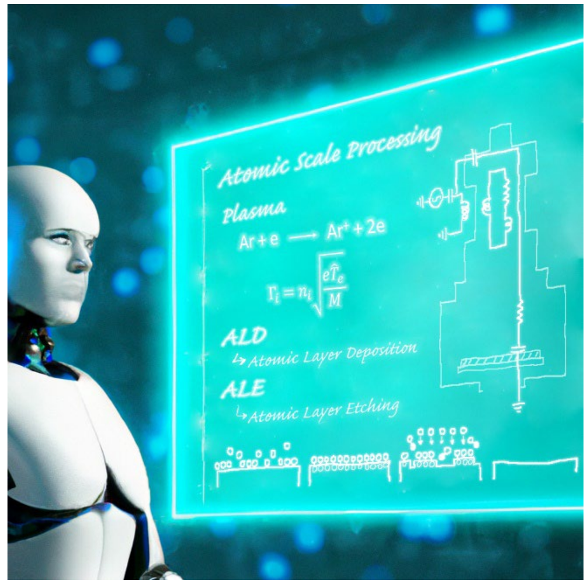
Call for Contributions

Please submit content for the next issue of the Newsletter. Please send your contributions to iltpc-central@umich.edu by **May 19, 2023.** Please send contributions as MS-Word files if possible – and **avoid sending contributions as PDF files**.

In particular, please send **Research Highlights and Breakthroughs** using this ***template:*** https://mipse.umich.edu/iltpc/highlight_template_v05.docx. The highlight consists of an image and up to 200 words of text; please also send your image as a separate file (the recommended image format is JPG or PNG; the minimum file width is 800 px). The topic can be anything you want - a recently published work, a new unpublished result, a proposed new area of research, company successes, anything LTP-related. Please see the *Research Highlights and Breakthroughs* for examples.

LTP Perspectives: Policy, Opportunities, Challenges

After Enabling AI It Is Time for the Plasma Community to Benefit from AI



That artificial intelligence (AI) draws a great deal of attention lately probably hasn't gone unnoticed by the readers of this newsletter. Particularly the availability of bots such as ChatGPT has demonstrated to many of us the remarkable capabilities of AI. After decades of just being a promise, we suddenly have the opportunity to experience the power of AI ourselves. We start to realize that it will soon transform the way we live, work, and interact with the world around us.

Our low temperature plasma community has obviously played a key role in enabling the breakthrough of AI. By developing highly advanced etch and deposition methods for high-fidelity processing steps at the nanoscale, the low temperature plasma community has contributed to the development of all kinds of powerful hardware technologies important for AI. These include central processing units (CPUs), graphics processing units (GPUs), field-programmable gate arrays (FPGAs), and application-specific integrated circuits (ASICs). Although these don't always require the real cutting-edge process nodes, they do involve specialized circuits that have enabled the rapid progress of AI in recent years, allowing developers to train larger, more complex models and deploy AI applications more efficiently. Furthermore, AI will bring into play new computing paradigms, for example those based on neuromorphic chips involving a range of novel devices such as memristors that impose also other requirements on deposition and etching of materials.

Now the time has come that plasma processes not only enable AI but also benefit from AI. AI can improve semiconductor manufacturing processes, for example by increasing efficiency, reducing defects, and improving product quality. By leveraging machine learning algorithms to analyze large amounts of data, semiconductor manufacturers can gain insights into the manufacturing process that would be difficult or impossible to obtain manually. This will enable them to make more informed decisions and optimize their operations. Note that the notion that AI tools can be helpful for monitoring and controlling plasma processes is nothing new, as it was already realized more than 30 years ago. For example, an IBM team involving the highly valued member of our community, Prof. Gottlieb Oehrlein, published an article about the use of optical emission spectroscopy and mass spectrometry data for reactive ion etch process parameter estimation using neural networks in 1992. However, now – due to the advancement of technology to which our plasma community has contributed – we have entered the next stage.

This new stage is underlined by an article that was published last month in *Nature*. Keren Kanarik and co-workers on the team of Richard Gottscho at Lam Research Corporation report how semiconductor process development can be improved by humans partnering with computers and AI algorithms now that large amounts of data are becoming available and can be processed easily. They set out a strategy to be followed and it becomes absolutely clear that AI will soon revolutionize the way our plasma community works in the semiconductor industry. (Written with the help of ChatGPT. Figure credit: De Digitale Vormgever.)

Prof. Erwin Kessels
Eindhoven University of Technology, The Netherlands
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Armelle Vardelle – An Enthusiastic Professor of Thermal Spraying and Material Treatment by Plasma Processes

Armelle Vardelle, distinguished Emeritus Professor at the University of Limoges in France, has been actively involved in thermal spray research at the Institute of Research for Ceramics (IRCER), a CNRS joint research unit focused on ceramic materials and surface treatment.

At the end of the seventies, she defended her PhD thesis under the supervision of Profs. P. Fauchais and R. Mac Pherson on an original work related to velocity and temperature measurements of solid particles injected in a thermal plasma jet. Armelle also started pioneering numerical studies on plasma flow development and material processing in arc plasmas, so far with a fundamental work on 3D transient arc modelling in non-transferred plasma torches. Her interest in thermal spraying technologies and their industrial applications has led her to develop a dual approach of fundamental modelling of plasma processing of materials complemented by experiments involving the deposition of coatings.

Driven by an acute awareness and deep attention to thermal spray issues, Armelle's research activity has covered many topics. These include numerous collaborations with industrial partners, which has developed into her impressive and endless dedication to her professional commitments. How many times upon returning from a conference, has she exclaimed with an infectious enthusiasm "I saw very interesting talks and discussed with colleagues, let's go ahead!"

Armelle has received several awards and honors for her contributions to thermal spray science, including Fellow of ASM International, Fellow of the International Plasma Chemistry Society and the prestigious Hall of Fame Award from the ASM International Thermal Spray Society in 2016. To date, she is the only woman to receive this recognition. She has also served as Editor-in-Chief of the *Journal of Thermal Spray Technology* between 2016 and 2022. In 2017, she was made a Knight of the Legion of Honor.

Accessible and open-minded, Armelle has always been able to communicate her scientific and technical knowledge with enthusiasm and pedagogy by bridging the gap between academic research and the industrial world. In particular, she has done pioneering work on the Life Cycle Assessment of plasma processes and materials in collaboration with Prof. N. J. Themelis from Columbia University. She is a founding member of CITRA, Engineering Center in Surface Finishing and Coatings for technology transfer in thermal spray, CVD, PVD and electroplating.

Armelle was also highly appreciated by her graduate students whom she taught for many years at the ENSIL/ENSCI engineering school of the University of Limoges, of which she was one of the pillars of its foundation. Her determination to develop and support her teaching of materials and surface treatment processes has enabled her to train several generations of engineers who are employed in many companies, particularly in the aeronautical field. Thanks to progressive weaving training, research and industrial applications, Armelle has strongly contributed to the creation of the joint laboratory between IRCER, SAFRAN and OERLIKON in 2019 and the advanced deposition platform SAFIR, which gathers most of state-of-the-art thermal spray and PVD equipment. Research and industrial applications are closer than ever to accelerating the improvement of materials properties and deposition processes in a great and promising partnership that we owe much to Armelle.

Prof. Gilles Mariaux and Dr. Vincent Rat
University of Limoges, France
gilles.mariaux@unilim.fr, vincent.rat@unilim.fr

- **26th International Plasma School on "Low Temperature Plasma Physics: Basics and Applications" and Master Class**

We invite you to attend the **26th International Plasma School on "Low Temperature Plasma Physics: Basics and Applications"** (September 30 – October 5, 2023) and its **Master Class "Advanced Diagnostics of Atmospheric Pressure Plasmas"** (October 5-7, 2023) to be held in Bad Honnef (Germany). The school follows a long tradition of 24 editions in person and one online in the past. The school and master class will be held again in the physics center in Bad Honnef.

The school provides an introduction to the fundamentals of plasma physics and gives an overview of the different research areas ranging from modeling of fluids to plasma spectroscopy or high pressure plasmas. An intensive exchange with the lecturers and other students from the research area is possible and desired. The enthusiastic support of many teachers and experts willing to give lectures at the Plasma School allowed us to compile, once more, a very promising program.

Information on the school and registration are available on the website: **http://www.plasma-school.org**. We kindly ask you to save the date and to spread this information to your colleagues and/or students who might be interested.

IOC: **Prof. Dr. Jan Benedikt, Prof. Dr. Holger Kersten** (Kiel University)
LOC: **Dr. Marina Prenzel, Prof. Dr. Achim von Keudell, and Dr. Marc Böke** (Ruhr University Bochum)

The school is part of the activities of the Research Department "Plasmas with Complex Interactions" at the Ruhr-Universität Bochum (RUB). The scientific organization is realized by the Christian-Albrechts-Universität Kiel (CAU).

Contact:
Research Department Plasmas with Complex Interactions
http://www.plasma-school.org
rd-plasma@rub.de

Meetings and Online Seminars

- **The Online Low-Temperature Plasma (OLTP) Seminar Series**

  The schedule for OLTP seminars and more information on the program, including links to past seminars, can be found at the OLTP website:

  https://theory.pppl.gov/news/seminars.php?scid=17&n=oltp-seminar-series

  The seminars are held on Tuesdays at 10:00 am EDT or EST via Zoom and are free to access.

  Co-Chairs:

  Dr. Mikhail Shneider, Princeton University, USA, shneyder@princeton.edu
  Prof. Dr. Vasco Guerra, University of Lisboa, Portugal, vguerra@tecnico.ulisboa.pt

- **IOPS Online Seminars**

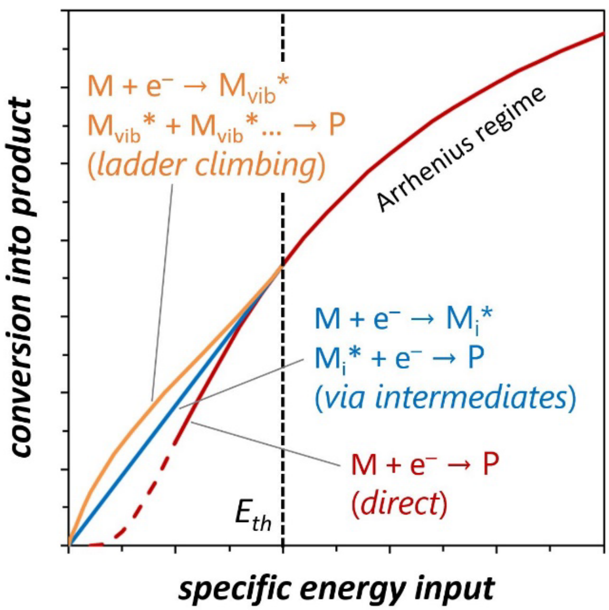
  The *International Online Plasma Seminar (IOPS)* is continuing to provide the international community with regular opportunities to hear from leading researchers in the field. The program of the IOPS (and links to past seminars) can be found at: http://www.apsgec.org/main/iops.php.

  Chair:
  Prof. Quan-Zhi Zhang, Dalian University of Technology, China, qzzhang@dlut.edu.cn

Community Initiatives and Special Issues

- Please submit your notices for Community Initiatives and Special Issues to iltpc-central@umich.edu.

Plasma Activation Mechanisms Governed by the Specific Energy Input: Potential and Perspectives



The conversion of a monomer (M) into the desired product (P) in low-temperature plasmas is governed by the specific energy input (SEI) for plasma polymerization and gas conversion. While the former involves formation of intermediates yielding a linear increase below a threshold energy, E_{th}, followed by an Arrhenius-like behavior, collisions of vibrationally excited states can further enhance conversion and thus also energy efficiency.

Due to the distribution of energies in low temperature plasmas, plasma-chemical reaction pathways follow an Arrhenius-like behavior above a corresponding threshold energy, where the energy available per molecule, the SEI, determines the activation of the molecule. This work discusses fundamentals, potential and perspectives of using the macroscopic Arrhenius-like approach for plasma polymerization, e.g., of hydrocarbons, as well as gas conversion, e.g., CO_2 conversion. Both fields might thus benefit from each other, while the concept also points to limitations with respect to achievable energy efficiencies.

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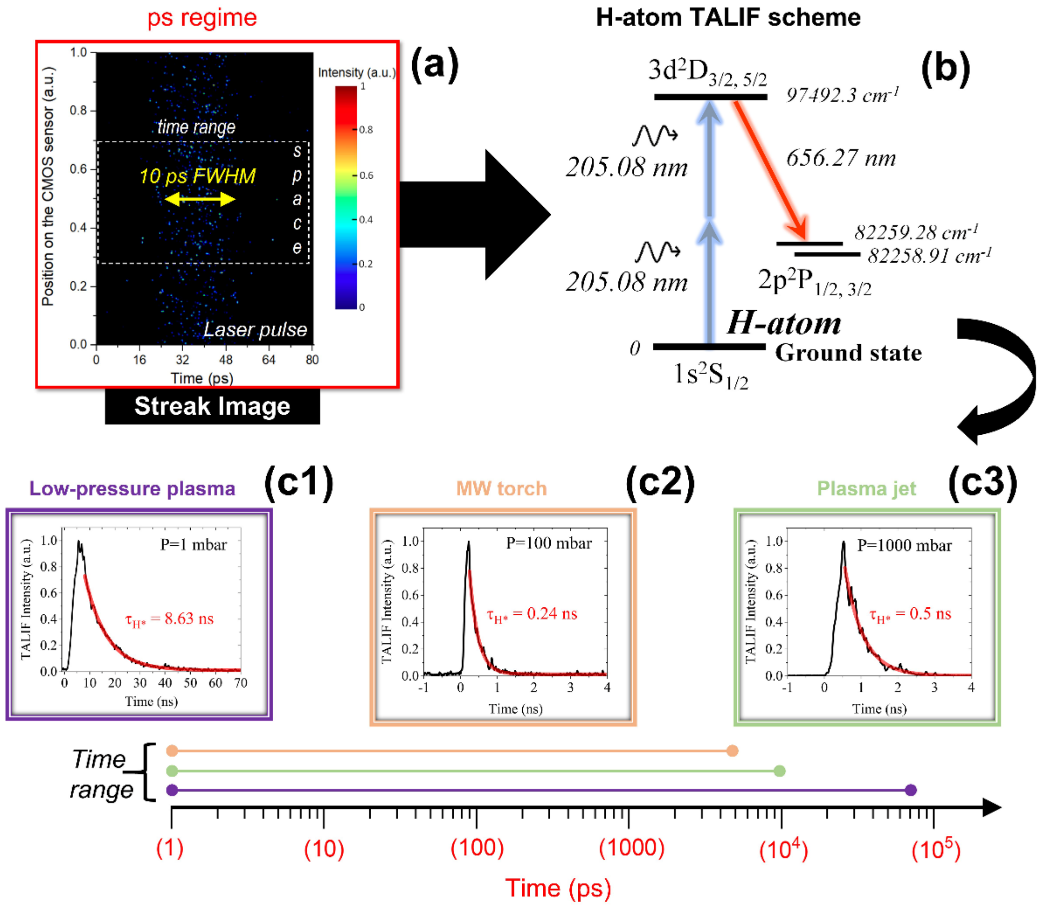
Source:
Plasma Process. Polym. **20**, e2300010 (2023).
https://doi.org/10.1002/ppap.202300010

Advanced Diagnostic Platform for Measuring Absolute Atomic Densities in Reactive Plasmas



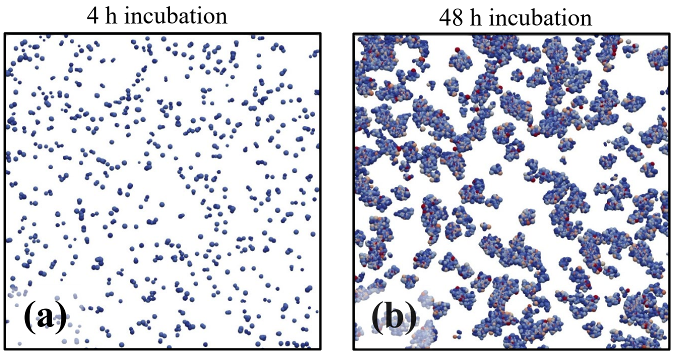
We present an advanced diagnostic platform involving an ultrafast picosecond (ps) laser and a streak camera for measuring absolute atomic densities in reactive plasmas. The temporal profile of the laser pulse (**a**; 10 ps FWHM around 205 nm) can be captured by the streak camera (few ps time resolution). In the streak image shown in **(a)**, the horizontal axis represents the time domain while the vertical axis refers to the space domain of the measurement (shown as position on the CMOS sensor of the streak). The laser and streak can be combined to perform Two-photon Absorption Laser Induced Fluorescence (TALIF) studies in discharges operating at low pressures (*P*). Moreover, due to the high temporal resolution, TALIF studies even at atmospheric pressure are feasible, where the quenching of laser-excited states becomes significant, thus complicating the application of classic ns–TALIF and –detectors. Here we illustrate ps–TALIF measurements of effective lifetimes (τ_{H^*}) of atomic hydrogen (an typical TALIF scheme is shown in **(b)**) in three reactive plasmas: microwave H_2 plasma (**c3**; *P*=1 mbar; τ_{H^*}=8.63 ns), microwave Ar/CH_4 plasma torch (**c1**; *P*=100 mbar; τ_{H^*}=0.24 ns), and atmospheric pressure helium plasma jet (**c2**; τ_{H^*}=0.5 ns). The accurate determination of these lifetimes is key to achieving more reliable measurements of H-atom absolute densities for different applications.

Contacts:

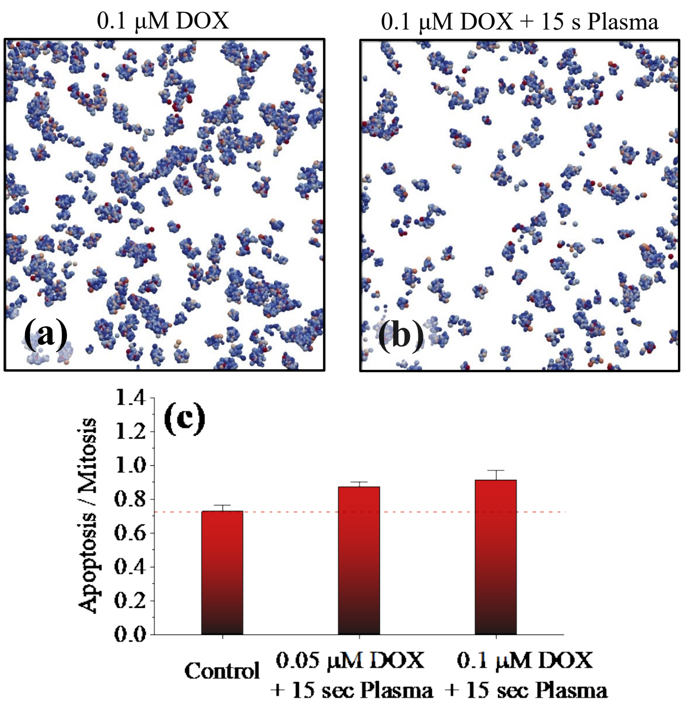
Dr. Laurent Invernizzi (laurent.invernizzi@lspm.cnrs.fr), **Dr. Swaminathan Prasanna** (swaminathan.prasanna@lspm.cnrs.fr), **Dr. Kristaq Gazeli** (kristaq.gazeli@lspm.cnrs.fr), **Prof. Guillaume Lombardi** (guillaume.lombardi@lspm.cnrs.fr), University Sorbonne Paris Nord, France.

Related publications : https://doi.org/10.1063/5.0041471, https://doi.org/10.3390/plasma4010009, https://hal.science/hal-03886543/.

Interrogating an *in silico* Model to Determine Helium Plasma Jet and Chemotherapy Efficacy against B16F10 Melanoma Cells



Simulated B16F10 cell number after **(a)** 4 hours and **(b)** 48 hours of incubation in the case of control (i.e., non-treated cancer cells).



Simulated B16F10 cell number after 48 hours of incubation **(a)** in the presence of 0.1 µM DOX in RPMI, and **(b)** 0.1 µM DOX in RPMI treated for 15 s with APPJ. **(c)** Cancer-cell apoptosis-to-mitosis ratio evaluated *in silico* for two scenarios of combined treatments using DOX and APPJ. The control is an average of five statistically independent in silico experiments). Our simulations demonstrate a significant enhancement in cell cytotoxicity of 2.25 and 4 times.

We developed an agent-based *in silico* approach to model B16F10 melanoma cell response to a helium atmospheric pressure plasma jet (APPJ) or/and doxorubicin drug (DOX). The model is informed by relevant data from *in vitro* experiments (cancer cell viability), providing detailed information on cell population number (N_{cell}) development during incubation and probability values for apoptosis ($\%P_{Apoptosis}$) and mitosis ($\%P_{Mitosis}$) following cell subjected to a plasma-conditioned RPMI-1640 medium, DOX, and DOX combined with APPJ.

The model reveals an impact on N_{cell}, $\%P_{Apoptosis}$, or/and $\%P_{Mitosis}$ of each treatment depending on the plasma duration and DOX concentration without using any flow cytometry experiments. Indicative simulations are shown in the image, revealing the effect on B16F10 cell dynamics of DOX alone, and combined DOX and direct APPJ treatments. Although our study here is focused on melanoma cell apoptosis and mitosis, other cell phenotypes (e.g., glioblastoma) and mechanisms (e.g., growth, migration, differentiation, etc.) can be specified in the model depending on the biology involved, treatment type, and application. Thus, the agent-based model can be expanded by adding more complexity such as plasma reactive species interaction pathways with cancer cells in different liquid media. As more evidence is provided to refine the model, the broader its applicability to explore more elaborate cancer treatment strategies.

This work was supported by the Research & Innovation Foundation (OPPORTUNITY/ 0916/ MSCA/ 0023).

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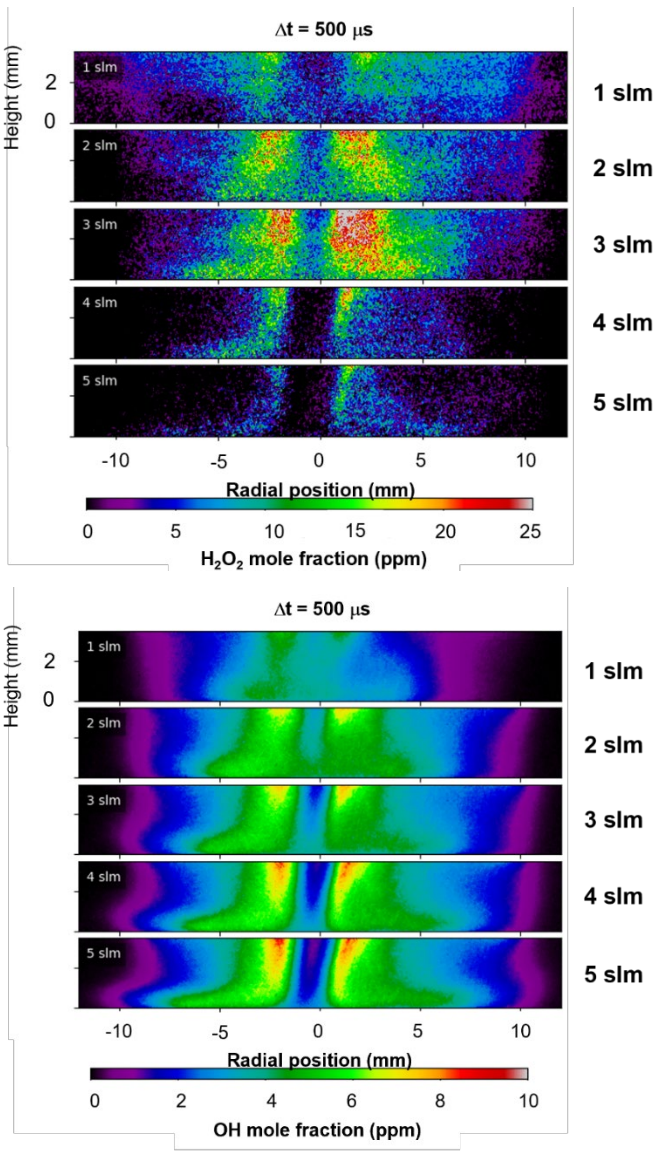
Source: Appl. Phys. Lett. **120**, 054101, 2022. https://doi.org/10.1063/5.0077694, https://bitbucket.org/vasvav/invitro_neuro/src/master/

2D-imaging of Absolute OH and H_2O_2 Profiles in a He–H_2O Nanosecond Pulsed Dielectric Barrier Discharge



H_2O_2 and OH mole fraction profiles for a range of flow rates at 500 us after the discharge burst in a pulsed DBD plasma jet using He-H_2O admixture.

Pulsed dielectric barrier discharges (DBD) in He–H_2O and He–H_2O–O_2 mixtures are studied in near atmospheric conditions using temporally and spatially resolved quantitative 2D imaging of the hydroxyl radical (OH) and hydrogen peroxide (H_2O_2). The primary goal was to detect and quantify the production of these strongly oxidative species in water-laden helium discharges in a DBD jet configuration, which is of interest for biomedical applications such as disinfection of surfaces and treatment of biological samples. Hydroxyl profiles are obtained by laser-induced fluorescence (LIF) measurements using 282 nm laser excitation. H_2O_2 profiles are measured by photo-fragmentation LIF (PF-LIF), which involves photo-dissociating H_2O_2 into OH with a 212.8 nm laser sheet and detecting the OH fragments by LIF. The H_2O_2 profiles are calibrated by measuring PF-LIF profiles in a reference mixture of He seeded with a known amount of H_2O_2. OH profiles are calibrated by measuring OH-radical decay times and comparing these with predictions from a chemical kinetics model. Dynamics of OH and H_2O_2 distributions in the afterglow of the discharge are investigated. Time-resolved images of the OH profiles revealed that OH radicals mostly decayed after 1 ms, while H_2O_2 was still present at significant mole fractions after 5 ms. The mole fraction profiles of OH and H_2O_2 tend to be concentrated in an annulus around the plasma discharge at short time scales and evolve into a typical stagnation flow profile as time progresses.

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Prof. Tanvir Farouk
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Source: D. van den Bekerom, M. Tahiyat, E. Huang, J. Frank, and T. Farouk, Plasma. Sources Sci. Technol. **32**, 015006, (2023).
https://doi.org/10.1088/1361-6595/acaa53

Evaluation of Selected Properties of Dielectric Barrier Discharge Plasma Jet

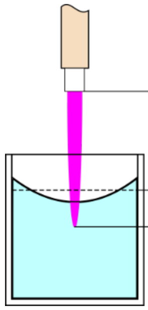

Figure 1. The plasma jet impinges on the liquid surface and slightly dives into the liquid.

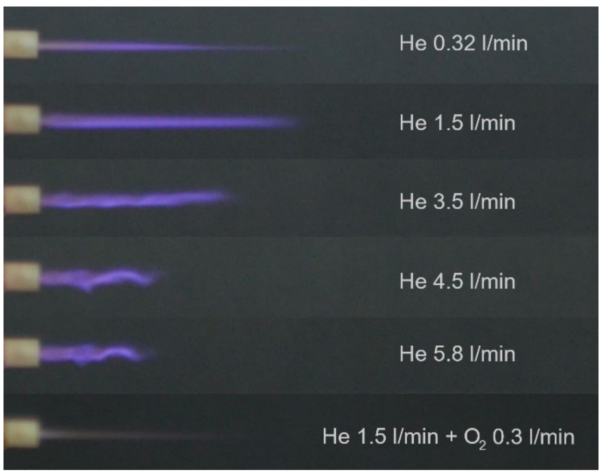

Figure 2. The shape of the discharge for different gas flow rates and compositions of the mixture.

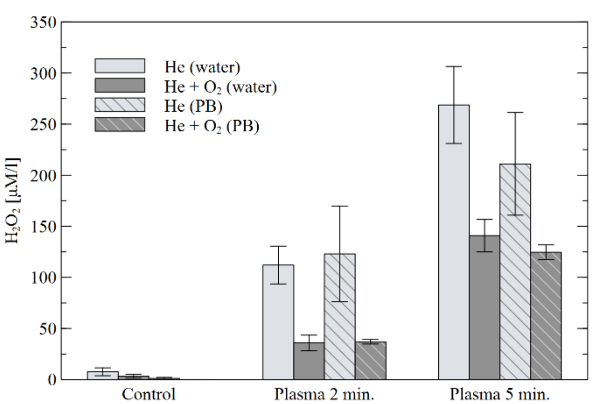

Figure 3. Concentration of H_2O_2 in plasma treated water and phosphate buffer.

In technological processes requiring mild treatment, such as soft materials processing or medical applications, an important role is played by non-equilibrium plasma reactors with dielectric barrier discharge (DBD) that, when generated in noble gases, allows for the effective treatment of biological material at low temperature. The aim of this study is to determine the operating parameters of an atmospheric pressure, radio-frequency DBD plasma jet reactor for the precise treatment of biological materials. The tested parameters were the shape of the discharge (its length and volume), current and voltage signals, as well as the power consumed by the reactor for various composition and flow rates of the working gas. To determine the applicability in medicine, the temperature, pH, concentrations of H_2O_2, NO_2^- and NO_3^-, and *Escherichia coli* log reduction in the plasma treated liquids were determined. The results show that for certain operating parameters, a narrow shape of plasma stream can generate significant amounts of H_2O_2, allowing for the mild decontamination of bacteria at a relatively low power of the system, safe for the treatment of biological materials. Examples include precise biomedical treatments, such as wound healing, oral cavity infections or localized tumor treatment.

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Prof. Zdenko Machala
Comenius University Bratislava, Slovakia
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Source:
Materials **16**, 1167 (2023).
https://doi.org/10.3390/ma16031167

New Resources

- Please submit your notices for New Resources to iltpc-central@umich.edu.

Career Opportunities
(for other career opportunities, see: https://mipse.umich.edu/jobs.php)

- **Post-doctoral Researcher in Experimental Plasma Physics, University of Augsburg, Germany**

  The Institute of Physics at the University of Augsburg, Germany is looking for a post-doctoral research in experimental plasma physics The group's research (https://www.uni-augsburg.de/en/fakultaet/mntf/physik/groups/epp/) is focused on molecular low-temperature plasmas, their diagnostics and the mutual influence of plasma-surface-interaction in close collaboration with the Max Planck Institute for Plasma Physics (IPP) in Garching. Several low-pressure discharges (ICP, ECR) and a microwave experiment in the medium pressure range are operated. The position is within the topic of plasma conversion of low energy molecules into value-added chemicals. The research contributes to the power-to-gas initiative in the field of energy storage, hydrogen technology, and chemical energy carriers. Lately, a DBD setup was commissioned to extend the accessible pressure range to atmosphere. The current research focusses on the fundamental understanding of the processes within hydrogen/nitrogen plasmas in view of nitrogen fixation and hydrogen storage via ammonia employing catalyst-assisted low-temperature plasmas.

  - Systematic characterisation of plasma sources (predominantly DBDs) with established diagnostics, expanded by insights into the plasma-catalyst interaction using ex-situ surface analysis techniques.
  - Optimization of the plasma sources in view of catalyst-enhanced ammonia formation and hydrogen storage.
  - Evaluation of the data and dissemination of the obtained results (conferences, journal publications).

  Your profile / our requirements:

  - Completed doctoral thesis in plasma physics, catalysis, or related fields.
  - Experience with experimental techniques related to plasmas, gases and surfaces (e.g., OES, FTIR, MS) and a solid basic understanding of low-temperature plasmas.
  - Experience in the operation and characterisation of plasma sources, in particular in atmospheric plasmas and DBDs.
  - A strong scientific track record, including publications in peer-reviewed journals.
  - Motivation to participate in teaching within the given university courses, supervision of students and in the group's initiatives for public relations.

  Position is available now until 31.12.2025. The position is intended full-time, but can also be filled part-time, provided that job-sharing ensures that the duties can be performed full-time. Applications should be transmitted by **April 15, 2023.** Applications together with the usual documents should be sent to:

  Contact:
  Prof. Ursel Fantz
  University of Augsburg
  ursel.fantz@physik.uni-augsburg.de

- **Program Director, National Science Foundation ENG/CBET - Process Systems, Reaction Engineering, and Molecular Thermodynamics, Washington DC, USA**

  The National Science Foundation's (NSF) Division of Chemical, Bioengineering, Environmental, and Transport Systems (CBET) is searching for a program director to lead the Process Systems, Reaction Engineering, and Molecular Thermodynamics program. The selected individual will oversee the program's merit review process, make funding recommendations, administer awards, and interact with research community members and other federal agencies. Program directors also provide intellectual leadership to meet NSF's strategic goals. A full description of the open position, eligibility requirements, and expected qualifications can be found on the NSF website (CBET-2023-95388). The program is currently a participant in NSF ECLIPSE, a cross cutting collaboration on plasma science and engineering.

  The position is offered as an Intergovernmental Personnel Act (IPA) assignment (i.e., a rotator position). IPA assignments typically range from two to four years, depending on mutual agreements between NSF, the assignee, and the assignee's home institution. The primary point of contact for this opening who can answer questions about the position and NSF is listed below:

  Contact:
  Dr. Christina Payne
  National Science Foundation, USA
  cpayne@nsf.gov, +1 703 292-2895

- **PhD Researcher in Lightning Studies using LOFAR Radio Telescope, The Netherlands**

  We are looking for an enthusiastic candidate with a strong background in data analysis and interest in exploring the physics of radio emission from lightning using data from the LOFAR radio telescope.

  Despite being a common and energetic event, lightning is still poorly understood. We do not know how it initiates, propagates, or even why it emits radio energy. Our group uses the LOFAR radio telescope which, although primarily designed for radio astronomical research, provides extremely precise and accurate images of lightning propagation with nanosecond and meter-scale resolution that allows us to probe lightning on the small scales needed to uncover the physics behind lightning phenomena.

  In this project the student will use LOFAR data to analyze lightning in order to understand how lightning initiates and grows, where there is flexibility to adjust for the student's interests. This will include contributing to our analysis pipeline by either improving existing techniques or developing new analyses, in addition to applying analyses to better understand lightning physics.

  Job requirements:
  - Master's degree in physics, astronomy, engineering, or a related discipline (or close to finishing).
  - Experience in experimental data analysis.
  - Good verbal and written communication in English.
  - Strong coding skills (C, C++, Fortran, or python).
  - Skillsets in statistics, antenna systems, and Fourier-frequency based analysis is a plus.

  For more information about ASTRON or this vacancy, please contact the PI listed below, visit www.astron.nl and www.jobsatastron.nl, or contact the HR department via: hr@astron.nl. The first closing date is **1 May 2023** at 9:00 AM local CEST. Candidates will be considered until the position has been filled.

  Contact:
  Dr. Brian Hare
  Netherlands Institute for Radio Astronomy, The Netherlands
  hare@astron.nl

- **PhD Positions in Environmental and Biomedical Applications of Plasmas, Comenius University, Bratislava, Slovakia**

  Faculty of Mathematics, Physics and Informatics of Comenius University in Bratislava, Slovakia is seeking highly qualified applicants for 4-year doctoral program**s** starting in September 2023.

  Information: **http://enviro.fmph.uniba.sk/index.php?lang=english&link=phd-2023**

  Topic 1: Honeycomb discharge for diesel exhaust treatment: To study plasma discharges generated and combined with honeycomb catalysts using both classical and new electrical and optical diagnostic methods for discharge characterization. To study the chemical reactivity and removal of synthetic pollutants as well as real exhaust from a diesel engine. Focus will be on honeycomb discharge reactor configuration, catalysts composition and its conductivity, temperature, composition and humidity of exhaust gases, discharge power, etc. A potential candidate should be an enthusiastic person with a solid knowledge and experience in chemistry, chemical catalysis or plasma catalysis. Laboratory research experience is required. The minimal requirements include a completed Master level degree in the intended area of study or a closely related area.

  Applicants are required to submit their CV with a list of publications and brief motivation letter to **Prof. Karol Hensel** (hensel@fmph.uniba.sk)

  Topic 2: Inactivation pathways induced in bacteria and biofilms by cold atmospheric plasma: To study inactivation pathways of various bacterial strains and biofilms induced by atmospheric air pulsed streamer corona discharge and self-pulsing transient spark discharge. The discharges will be applied directly to planktonic bacteria in water and saline solutions, and single- and mixed- species bacterial biofilms on various surfaces. A potential candidate should be an enthusiastic person with a solid knowledge and experience in clinical medicine, microbiology, biotechnology or plasma medicine. Laboratory research experience is required. The minimal requirements include a completed Master level degree in the intended area of study or a closely related area.

  Applicants are required to submit their CV with a list of publications and brief motivation letter to **Prof. Karol Hensel** (hensel@fmph.uniba.sk).

  Topic 3: Study of the effects of cold plasma and plasma-activated liquids in infections*:* The key objectives are investigations of cold plasma and plasma-activated liquids (PAL) effects on infections, e.g., in wound disinfection and stimulated healing, or urinary infections. The related objective is the description of ways of immunocompetent cells stimulation through the analysis of activation of NETosis by cold plasma or PAL. Program includes experimental investigations and spectroscopic measurements of the aqueous reactive species in water solutions activated by various types of plasma discharges, and ex-vivo tests of wound disinfection by cold plasma and PAL on gelatin and skin models. The potential candidate should be an enthusiastic person with a solid knowledge and experience with experimental physics/biophysics and microbiology.

  Applicants are required to submit their CV with a list of publications and brief motivation letter to **Prof. Zdenko Machala** (machala@fmph.uniba.sk).

- **Post-doctoral Positions in Biomedical and Environmental Applications of Plasmas, Comenius University, Bratislava, Slovakia**

  Faculty of Mathematics, Physics and Informatics of Comenius University in Bratislava, Slovakia is currently seeking highly qualified applicants for post-doctoral positions.

  Information: **http://enviro.fmph.uniba.sk/index.php?lang=english&link=postdoc-2023**

  Topic 1*:* ***Direct effects of plasma and indirect effects of plasma-activated liquids (PAL) combined with electric field and UVA radiation on bacteria and biofilms:*** 1) Examining direct plasma effects and indirect PAL effects combined with electric field and UVA radiation on planktonic bacteria, focusing on physiological processes, such as cultivability, sublethal damage, cell membrane electropermeabilization / poration and lipoperoxidation, mutagenic effects, etc. 2) Effects of plasma/PAL combined with electric field and UVA radiation on and bacterial biofilms and prevention of their growth and inhibiting bacterial initial adhesion to the surface of polymeric tubular materials (catheters). A potential candidate should be an enthusiastic person with a solid knowledge and experience in (micro)biology. Experience with electrical discharges and plasmas and spectroscopic chemical analyses is welcome. The minimal requirements include a completed PhD level degree in the intended area of study or a closely related area. Applicants are required to submit documents listed below by e-mail to **Prof. Zdenko Machala** (machala@fmph.uniba.sk).

Topic 2: Honeycomb discharge for diesel exhaust treatment: To study plasma discharges generated and combined with honeycomb catalysts using both classical and new electrical and optical diagnostic methods for discharge characterization. To study the chemical reactivity and removal of synthetic pollutants as well as real exhaust from a diesel engine. Focus will be on honeycomb discharge reactor configuration, catalysts composition and its conductivity, temperature, composition and humidity of exhaust gases, discharge power, etc. A potential candidate should be an enthusiastic person with a solid knowledge and experience in chemistry, chemical catalysis or plasma catalysis. Laboratory research experience is required. The minimal requirements include a completed PhD level degree in the intended area of study or a closely related area. Applicants are required to submit documents listed below by e-mail to **Prof. Karol Hensel** (hensel@fmph.uniba.sk).

The **deadline for applications is May 15, 2023**. Post-doctoral position is expected to start **from October 2023** for 1 year (with optional extension by one more year). **Required documents**: CV with a list of recent publications, copy of PhD diploma, brief motivation letter, recommendation letter.

- **Post-doctoral Research Fellow, Modeling and Simulation of Low-Temperature Plasma-Assisted Ignition, University of Texas, USA**

The Reactive Flow Modeling Laboratory (https://sites.utexas.edu/flow) headed by Prof. Fabrizio Bisetti at the University of Texas, Austin, USA is engaged in research on the use of low-temperature non-equilibrium plasmas for efficient and reliable ignition of hydrocarbon/air mixtures in scramjets, power generation, and transportation applications. A postdoctoral fellow position is available **immediately**. The appointment is yearly and renewable for **up to 3 years** based on performance and availability of funding.

The postdoc will perform large-scale high-fidelity simulations of plasma discharges and ignition of combustible mixtures in the presence of turbulence and mixture inhomogeneities. Simulations will be conducted using massively parallel plasma and reactive flow solvers based on the AMReX library for block-structured adaptive mesh refinement developed at NREL as part of a DOE's Exascale Computing Project. The postdoc will present at scientific conferences and disseminate research in the form of peer reviewed articles in high-impact journals. The postdoc will help the principal investigator (PI) with graduate student supervision and acquire experience with preparing grant proposals.

Strong background and experience in one or more of combustion and reactive flows, plasma physics and modeling, fluid mechanics, applied mathematics, parallel software development, and large-scale simulations on high-performance computing platforms are desirable. Interested candidates should contact the PI submitting CV, two sample publications or manuscripts, and a brief cover letter with career and research highlights.

Contact:
Prof. Fabrizio Bisetti
University of Texas, Austin, USA
fbisetti@utexas.edu

- **Experimental Post-doctoral Appointee, Optical Diagnostics of Plasma, Sandia National Laboratories, Albuquerque, NM, USA**

The Applied Optical and Plasma Science Department at Sandia National Laboratory (Albuquerque, NM) is seeking a dedicated Postdoctoral Appointee to conduct fundamental research developing active and passive optical diagnostic techniques examining plasmas used in a wide range of applications. The successful candidate will assist in research leading to new scientific insights aiding Sandia in its mission to serve the nation. You will interrogate a variety of plasma systems increasing our ability to understand the process of electrical breakdown and work in collaboration with members of our computational plasma physics team to increase our fundamental knowledge of these systems. On any given day, you may be called on to:

- Establish new scientific insight on the physical mechanisms underlying low temperature plasma phenomena.
- Publish scientific results and participate in the scientific community.
- Collaborate with external partners through Sandia's Low Temperature Plasma Research Facility (https://www.sandia.gov/prf/).
- Use plasma diagnostic tools for new applications.
- Develop or otherwise support the development of new diagnostic tools for interrogating plasma initiation and steady states.
- Support verification and validation of plasma simulation tools in collaboration with modelers.

***Qualifications we require*:** A PhD in Physics, Electrical Engineering, Nuclear Engineering, Mechanical Engineering, Chemistry, or relevant STEM field; experience with optical diagnostics or low temperature plasma experiments; able to acquire and maintain a Department of Energy Q-level security clearance.

Qualifications we desire: Proficiency with varied communication methods, experience with LabVIEW, MATLAB, Python, or other data interpretation scripting/programming tools; experience with setting up and operating experimental systems to study plasma generation, including plasma sources, high voltage discharge circuits, and pressure and vacuum systems; experience with optical emission spectroscopy (OES), laser-induced fluorescence (LIF), absorption spectroscopy, Thomson scattering, Raman scattering, electric-field-induced second harmonic generation (EFISH), optical tomography, surface spectroscopy, coherent anti-Stokes Raman spectroscopy (CARS); record of publications in peer-reviewed journals and presentations at scientific conferences.

More information: https://sandia.jobs/albuquerque-nm/optical-diagnostics-of-plasma-experimental-postdoctoral-appointee/DCD5D71B352942E58FCB366A667FCA65/job/

Contact:
Dr. Brian Bentz
Sandia National Laboratory, USA
bzbentz@sandia.gov

Collaborative Opportunities

Please submit your notices for Collaborative Opportunities to iltpc-central@umich.edu.

Disclaimer

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