International Low Temperature Plasma Community

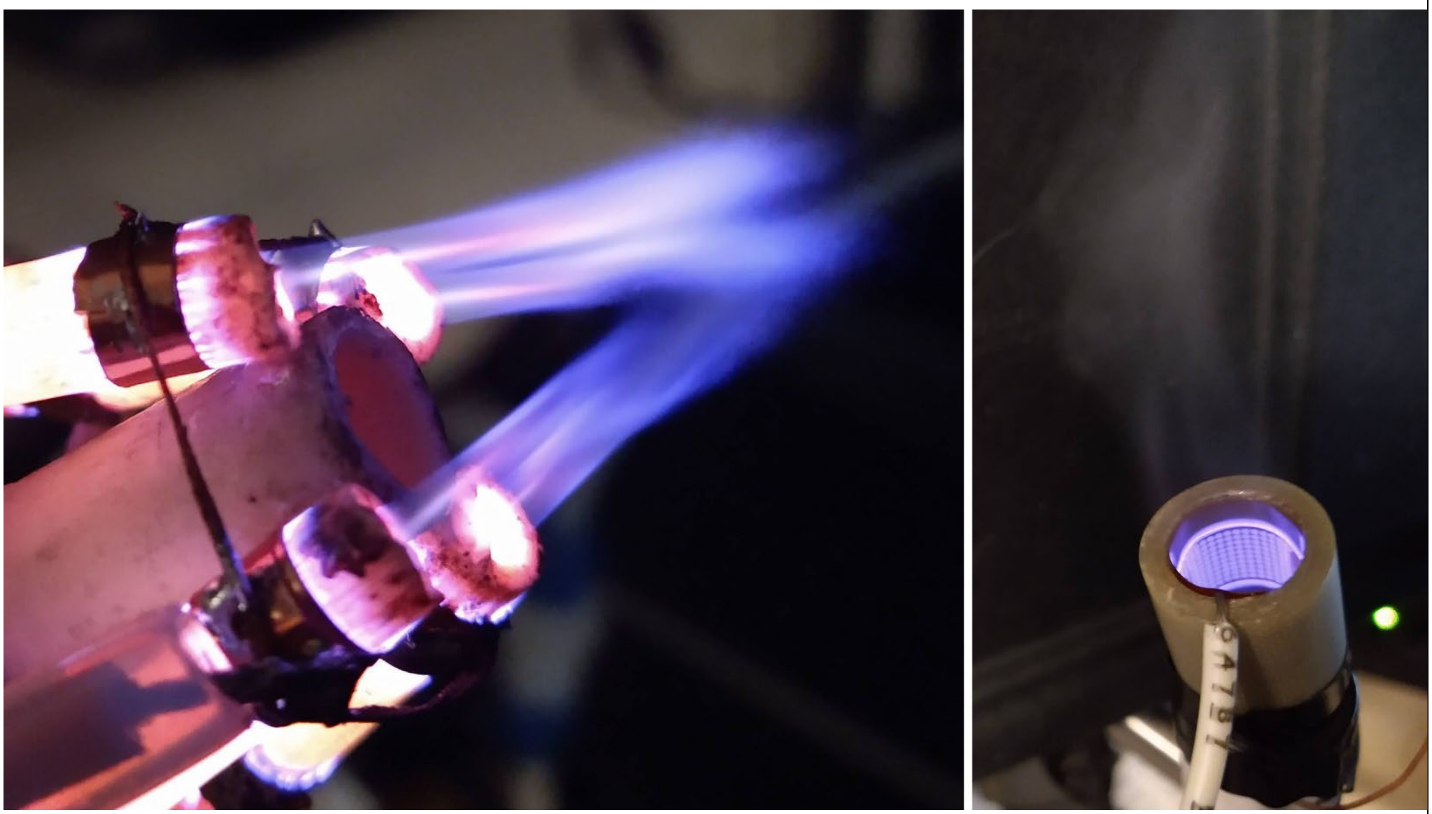
https://mipse.umich.edu/iltpc.php, iltpc-central@umich.edu

Newsletter 23

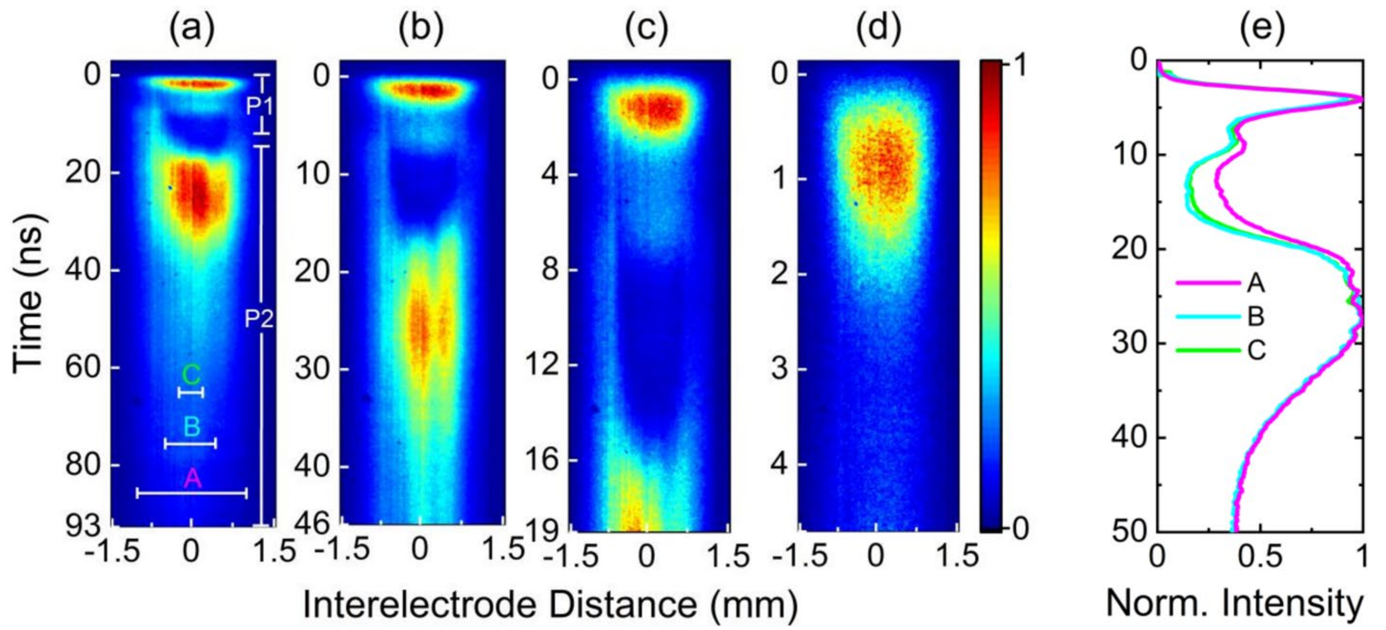
18 May 2022

Images to Excite and Inspire!

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



Decontaminating Gas Flows: The images show plasma sources designed for activating aerosols and decontamination of gas flows. On the left is a quadro-barrel jet configuration. On the right is the tubular DBD configuration. The quadro-barrel jet consists of four Helium plasma jets from a single kHz power supply. The jet plumes are co-aligned on the axis where outflow from a tube is located. The central tube can run either aerosol or gas. The jet-based device requires He gas for operation, but might offer an advantage in the formation of He metastable species that are known to impact plasma-induced chemistry, especially further away from the actual plasma. The tubular DBD is a light, small print device, also operated by a compact kHz power supply. The tubular DBD operates in open air and does not require any noble gas for ignition. Both devices are capable of activating aerosol flowing through the tube. Collected water mist that ran through the plasma shows presence of hydrogen-peroxide (H_2O_2, ≈10 ppm). Currently experiments are being conducted to investigate bacterial deactivation with these devices using activated aerosol. These experiments were at the central part of a collaborative user project of Princeton University at the Princeton Collaborative Research Facility (PCRF, https://pcrf.princeton.edu/). **Dr. Shurik Yatom** (syatom@pppl.gov), Princeton Plasma Physics Laboratory, USA; **Dr. Maksim Mezhericher** (maksymm@princeton.edu) and **Prof. Howard Stone** (hastone@princeton.edu), Princeton University, USA.



Ultra-time Resolved Imaging and Spectroscopy of Nanosecond Pulsed Plasmas: The temporal dynamics of atmospheric-pressure nanosecond pulsed plasma discharges in a pin-to-pin electrode configuration are studied using streak-camera line imaging of the interelectrode gap. Presented here are streak images of the plasma emission in the 2 mm gap between the electrodes for streak camera sweep times of (left to right) 100 ns to 5 ns, with corresponding temporal resolutions of approximately 500 ps to 25 ps, respectively. The discharge emission initiates homogeneously throughout the interelectrode gap with no detectable streamer propagation and then temporally decays in two distinct phases. The emission is also studied using spectral filters to measure the time evolution of different plasma species. The dominant contributions to the emission in Phase 1 (~0-15 ns) are from N_2(C–B) and N_2^+(B–X), whereas in Phase 2 (~15-100 ns) the dominant contributions are from NO* and N_2(B–A). There is a significant contribution from NO* between ~15–40 ns after a single spark discharge, indicating a large mole fraction of NO. The temporal evolution of O(^{1}D) coincides with N_2(B–A) emission and not N_2(C–B) emission. The current results provide continuous measurements of plasma emission for a single discharge with unprecedented sub-ns temporal resolution, revealing interesting ultra-fast dynamics in the first several nanoseconds of the discharge that are missed by other measurement approaches. The measurable signal levels from radicals such as O(^{1}D) and NO* at ps temporal resolution open up the possibility of comprehensive and quantitative time-dynamics studies including other relevant major chemical species. (Image from Patel et al., Applied Physics Letters **120**, https://doi.org/10.1063/5.0073630). **Prof. Sally Bane**, Purdue University, USA, sbane@purdue.edu.

In this issue:

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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 **June 24, 2022.**

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

Can Plasmas Revolutionize the Water Treatment Industry?

Water treatment in its broadest sense seeks to convert or degrade toxic chemicals into less harmful constituents. Electrical discharge plasmas, like all oxidation technologies, are capable of achieving this objective, although for most environmental contaminants, plasmas cannot compete with established destructive technologies. Outcomes from decades of research in plasma water treatment and the handful of commercial reactor systems together demonstrate that the development of a superior water treatment technology lies beyond the process's ability to merely produce reactive oxidative species. Despite the strong research momentum in the area of plasma-liquid interactions, the extent to which commercialization efforts will be advanced in the future remains uncertain.

So, will the water treatment industry ever be able to view plasma as a competitive process? When it comes to treatment of poly- and perfluoroalkyl substances (PFAS), the answer is a resounding yes! Plasma not only performs well, but in fact it is one of the most effective and efficient techniques for the destruction of these compounds. Known as the *Forever Chemicals*, PFAS are a large family of over 9,000 highly persistent and toxic chemicals not found in nature. The widespread use of PFAS in military, aerospace, automotive, construction and electronic industries, combined with their environmental release, mobility, fate and transport, has resulted in multiple exposure routes for humans. In fact, the water supplies of over 110 million residents of the United States (nearly one-third of the US population) are estimated to be contaminated with PFAS. The far-reaching impacts of pollution from PFAS chemicals on a small West Virginia community were dramatically presented in the 2019 film "Dark Waters."

In 2016, the US Environmental Protection Agency (EPA) set a non-enforceable health advisory level for only two PFAS compounds – perfluorooctanoic acid ("PFOA") and perfluorooctane sulfonic acid ("PFOS") at 70 ng/L. In 2021, the Biden Administration announced a multiagency plan to address PFAS contamination nationwide that includes expanding cleanup efforts to remediate its impacts. In response, the EPA announced the release of the *PFAS Strategic Roadmap: EPA's Commitments to Action 2021–2024*, which sets timelines by which EPA plans to take specific actions (https://www.epa.gov/system/files/documents/2021-10/pfas-roadmap_final-508.pdf). As long expected, EPA will propose to designate PFOA and PFOS as hazardous substances under the Comprehensive Environmental Response, Compensation, and Liability Act. In 2023, EPA also expects to publish its updated guidance on methods to destroy and dispose of PFAS. There is an air of anticipation awaiting this document, as effective destructive technologies that can work on a large scale are scarce. Just this month, the Department of Defense stopped using incineration—one of the most widely applied techniques for PFAS destruction—until it formally issues guidance on how to dispose of the substances.

PFAS contamination of water supplies, a problem of global proportions, will undoubtably remain for the foreseeable future. The competition for the best solution is fierce, with plasma consistently emerging as the most viable option. Although the science underlying plasma PFAS destruction is not well understood, the ability of these compounds to concentrate at interfaces (where plasma reactive species are generated) gives the technology its competitive edge. Furthermore, their degradation most likely depends on species not previously considered to play a role in contaminant removal, since PFAS are non-oxidizable. Therefore, plasma-based PFAS treatment represents a unique opportunity for our community to revolutionize this $12.1B industry while creating a positive environmental and societal impact. The magnitude of plasma's impact on water treatment may be comparable to that it achieved with the semiconductor industry.

Prof. Selma Mededovic Thagard
Clarkson University, USA
smededov@clarkson.edu

Leaders of the LTP Community: Career Profiles

Dr. Anne Bourdon — From Atmospheric Low Temperature Plasmas to Electric Propulsion of Satellites

Anne Bourdon is a researcher at the National Center for Scientific Research (CNRS) and deputy director of Laboratoire de Physique des Plasmas (LPP), a joint research laboratory between CNRS, École Polytechnique, Sorbonne Université, Université Paris-Saclay and Observatoire de Paris, France. Anne's research focuses on modeling and simulation of various important aspects of the low-temperature plasma physics including non-equilibrium discharges and reactive flows, atmospheric plasmas, plasma assisted combustion, atmospheric pressure low-temperature plasma jets, and plasma propulsion.

Anne's long-term research interest in low temperature plasmas at atmospheric pressure has led to several notable achievements including a computational model for photo-ionization in air which Anne has developed together with her co-workers. This model has become the reference for simulations of propagating ionizing fronts in air for many years.

Anne's endeavor is to challenge the results of modeling and simulations by direct comparison with experiments. For that she is keen to develop tailored numerical tools, dedicated, for example, to simulating propagating ionizing fronts in particular configurations of electrodes and dielectrics, or gas mixtures. This challenging approach led Anne to fruitful collaborations with a number of recognized experimental plasma physicists. Anne and her fellow co-workers have achieved recently the first quantitative experiment/modeling comparison of the spatially and temporally resolved electric fields for atmospheric pressure low-temperature plasma jets impacting the target surfaces. This strikes one of the key issues for applications of low temperature plasma jets: the understanding and the control of the electric field on the target surfaces.

Over the years, Anne's research interests expanded to the physics of $E \times B$ discharges relevant to plasma propulsion and similar technologies. Since 2016, Anne has been the holder of an Industrial Chair on *Future Plasma Thrusters for Low Earth Orbit Satellite Propulsion Systems* (POSEIDON) co-sponsored by Safran Aircraft Engines and the Agence Nationale de la Recherche. The main goals of the POSEIDON project were to better understand plasmas in the real architectures of Hall effect thrusters through the methodology of combining experiments and the development of 3D numerical tools for the simulation of such devices.

Anne has served in editorial boards of *Plasma Sources Science and Technology*, *Journal of Physics Communications* and since 2018 is a member of the editorial board of *Journal of Physics D: Applied Physics*. She has also been repeatedly awarded as a 'Top peer reviewer' in physics on *Publons*. Since January 2022, Anne has been a co-chair of the *Online Low Temperature Plasma Seminar*, a high-quality online seminar series started during the pandemic in 2020.

Anne is also a dedicated supervisor of PhD students. Her involvement in supervision is legendary and many of her PhD graduates has become skilled researchers and successful PhD supervisors themselves, passing Anne's spirit on to the next generations of scientists.

Anne is also a very active person apart from her life in the sciences. She is a theater enthusiast and a regular Yoga practitioner. She also learned Japanese during her studies, so she is surely the right person to hang out with while on conferences in Japan. And early birds at the crack of dawn can witness her jogging outdoors prior to a long conference days.

Bonne course Anne!

Dr. Zdeněk Bonaventura
Masaryk University, Brno, Czech Republic
zbona@physics.muni.cz

General Interest Announcements

Please submit your entry for General Interest Announcements to iltpc-central@umich.edu.

Meetings and Online Seminars

- **9th International Plasma Science and Entrepreneurship Workshop – 21 & 22 November 2022, York, UK**

The 9th International Plasma Science and Entrepreneurship Workshop will take place in **York, UK** on **21-22 November 2022**.

About 100 leading international scientists from universities, institutes and firms & scientific entrepreneurs are expected to participate. The workshop will be a PhD (student) expert-level workshop focused on the achievements, challenges and opportunities for the scientific- and entrepreneurial community working in the field.

Key topics and themes:

- Plasma medicine, medical and healthcare
- Plasma surface modification & thin films
- Atmospheric pressure plasma at micro/nano scale
- Atmospheric pressure plasma jet (APPJ)
- Nanoparticles generation and particle surface treatment
- Surface diagnostics, energetics, analytics and –metrology
- Plasma parameterization, diagnostics, simulation
- Plasma for emission abatement & CO_2
- Plasma parameterization, diagnostics, simulation

More information coming soon on the website: https://visiondynamics.nl/workshops/9th-plasma-workshop. We look forward to welcoming you at our workshop in November 2022 in York.

Contacts:
Dr. Erik Wagenaars (Scientific Chair & Host)
York Plasma Institute, University of York, UK
erik.wagenaars@york.ac.uk
Dr. Hugo de Haan (Entrepreneurship Chair)
Hugo.deHaan@visiondynamics.nl

- **75th Annual Gaseous Electronic Conference and 11th International Conference on Reactive Plasmas, Sendai, Japan**

  The 75th Annual Gaseous Electronic Conference is excited to announce it will be held jointly with the 11th International Conference on Reactive Plasmas on October 3 - 7, 2022, in Sendai, Japan.

  Call for Contributed Papers: Information about abstract submission: https://www.aps.org/meetings/abstract/submit.cfm. Abstract submission deadline: **June 10, 2022** (4:00 pm US Central Time).

  Student Award for Excellence: The GEC Student Award for Excellence recognizes the important contributions students make to the GEC. The eligibility and nomination materials can be found here https://www.apsgec.org/gec2022/awards.php.

  The Student Poster Prize: The GEC Student Poster Prize recognizes three student presented research posters for their contribution to the work and future of GEC. The eligibility and nomination materials can be found on the Awards site https://www.apsgec.org/gec2022/awards.php.

  Student Travel Grant: The Student Travel Grant provides funding to offset the cost of attending the conference in person (onsite). The grant will cover the full registration cost of the conference and partial coverage for lodging. Information can be found on the Grants and Scholarship site https://www.apsgec.org/gec2022/grants_scholarships.php.

  Invitation Letters: If a letter of invitation is needed to attend the conference, please contact Conference Secretariat (gec2022@senkyo.co.jp) with the following information:
  - Attendee name and salutation (Prof., Dr., Mr., Mrs., Ms., etc.)
  - Affiliation
  - Address
  - Title of the presentation/poster (if giving a presentation or poster)

  Contacts:
  Prof. Toshiro Kaneko, Tohoku University, Japan, kaneko@tohoku.ac.jp
  Dr. Julian Schulze, Ruhr University-Bochum, Germany, schulze@aept.ruhr-uni-bochum.de

- **New Webinar Series Asia Pacific - USA "Highlights in Low Temperature Plasma Physics"**

  We have the pleasure to invite you to attend the new webinar series Asia Pacific - USA "Highlights in Low Temperature Plasma Physics" sponsored by Princeton Plasma Physics Laboratory (PPPL) and the *Physics of Plasmas*.

  The series will be organized by *Physics of Plasmas* Editors and Editorial Board Members with the goal to facilitate the dissemination of scientific knowledge and present recent publications in *Physics of Plasmas* and other plasma journals. The series are intended to be focused on basic properties of low-temperature plasmas and their applications.

  If you would like to present or add emails to the list of attendees, please contact us.

  Contacts:
  Dr. Igor Kaganovich, Princeton Plasma Physics Laboratory, USA, ikaganov@pppl.gov
  Prof. Yong-Xin Liu, Dalian University of Technology, China, yxliu129@dlut.edu.cn
  Assistant Prof. Jian Chen, Sun Yat-sen University, China, chenjian5@mail.sysu.edu.cn

- **Online Seminars – OLTP and IOPS**

  The *Online Low Temperature Plasma* (OLTP) seminar series and the *International Online Plasma Seminar* (IOPS) are continuing to provide the international community with regular opportunities to hear from leading researchers in the field.

  - The program of the OLTP (and links to past seminars) can be found at:
    https://theory.pppl.gov/news/seminars.php?scid=17&n=oltp-seminar-series

    Dr. Anne Bourdon and **Dr. Igor Kaganovich**, OLTP Co-Chairs
    anne.bourdon@lpp.polytechnique.fr, ikaganov@pppl.gov

  - The program of the IOPS (and links to past seminars) can be found at:
    http://www.apsgec.org/main/iops.php
    Dr. Kallol Bera, IOPS Chair, kallol_bera@amat.com

Community Initiatives and Special Issues

- **Special Issue Research Topic in *Frontiers of Physics* on Non-equilibrium Effects in Plasma Afterglow and Effluent**

  For many applications, in particular for atmospheric-pressure plasmas, the locations of plasma generation and application are not the same, often both in space and time. For these plasmas, during the afterglow or effluent phase, the composition and properties of the plasma can change dramatically due to, for instance, recombination, transfer of short-lived radicals into longer-lived species and interactions with the environment (e.g. air or a substrate). Despite their key importance for several applications, the non-equilibrium aspects of afterglows and more particularly the effluent of flowing plasmas are not as well described as the traditional (powered) plasma phase. For instance, the importance of vibrational kinetics and the effects of air mixing with a plasma jet have recently been established, but there are many outstanding questions about the exact reaction mechanisms. Diagnostics are often challenging in afterglows due to the decreasing densities of species and transfer to often non-radiating species. For computational modeling there are challenges in determining relevant reaction mechanisms which will be different from traditional (powered) plasmas. Numerical models also require simplifying assumptions which cannot always a priori be justified in order to obtain a solution. Concerted experimental and modeling efforts are usually required to shine new light into non-equilibrium aspects of high-pressure plasmas.

  This Special Issue Research Topic aims to cover all aspects of plasma afterglows and effluents for both thermal and non-thermal plasma sources. Examples of topics of interest include, but are not limited to, non-equilibrium effects, vibrational kinetics, radical chemistry, nanoparticle nucleation and growth, catalysis in the afterglow, recombination and interactions of plasma with its environment. Contributions in which theory/modeling and experiments are combined are particularly encouraged. In addition, we welcome contributions that highlight limitations of existing knowledge in modeling and experiments (including so-called “failed experiments” provided they can help the state-of-the-art) for describing non-equilibrium plasmas, thereby setting the scene for future research.

  More information on this Research Topic can be found on the dedicated website:
  https://www.frontiersin.org/research-topics/35373/non-equilibrium-effects-in-plasma-afterglow-and-effluent

  The deadline for submissions is currently **13 July 2022.**

  Contacts:
  Dr. Erik Wagenaars, University of York, UK, erik.wagenaars@york.ac.uk
  Prof. Emile Carbone, Université du Québec, INRS, Canada
  Dr. Nikolay Britun, Nagoya University, Japan

Enhancement of CO_2 Conversion in Microwave Plasmas using a Nozzle in the Effluent

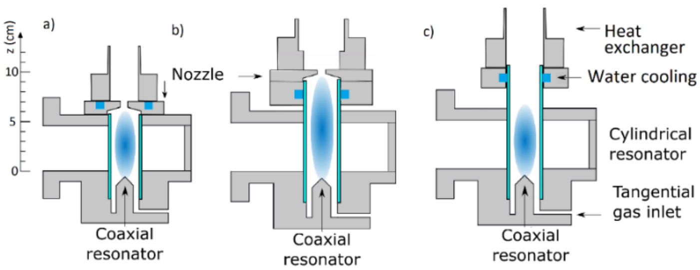


Figure 1. Schematic of the experimental setup showing the plasma torch (comprising a coaxial and a cylindrical resonator), and the nozzle mounted either on (a) the resonator (z = 65 mm), or (b) on top of the quartz tube (z = 100 mm). Sub-figure (c) shows a standard design without the nozzle.

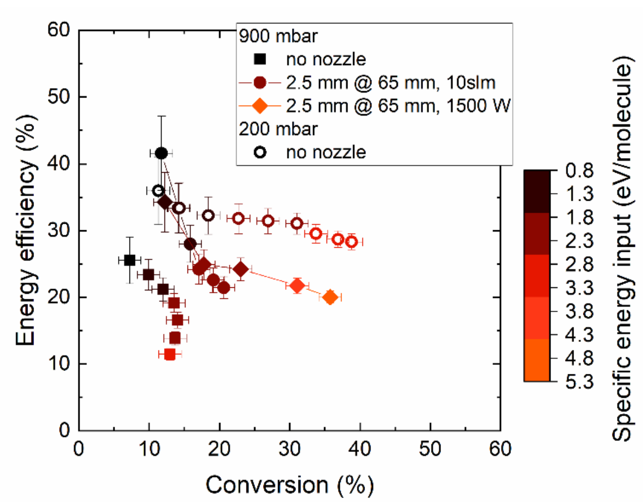


Figure 2. Conversion and energy efficiency of the CO_2 microwave plasma torch showing data without nozzle for 200 mbar (open symbols) and 900 mbar (squares). Results with the nozzle at z = 65 mm are shown at fixed parameter of either 10 slm (circles) or 1500 W (rhomboid), obtained at a constant pressure of 900 mbar. The colour coding of the symbols represents the Specific Energy Input (SEI).

Plasma conversion is an alternative approach to the electrochemical and photochemical technologies in the searching for the most efficient way to convert CO_2 into carbon monoxide (CO). In this work an investigation of the CO_2 conversion and the energy efficiency in a microwave plasma torch equipped with a nozzle of different diameters (Figure 1) is presented. The nozzle is installed downstream of the plasma at varying distances. The plasma torch operates within in the pressure range 100–900 mbar.

The results obtained using the nozzle demonstrate an enhancement of both conversion and energy efficiency, particularly at pressures close to atmospheric pressure and for lower CO_2 flows (SEI above 2 eV/molecule). The conversion and energy efficiency obtained *without the nozzle* plotted in Figure 2 show the strong decrease of the performance for 900 mbar when compared to 200 mbar. By using the nozzle, it is possible to significantly increase the performance of the plasma torch at a pressure of 900 mbar, both in conversion and energy efficiency towards values previously achieved only at 200 mbar with the standard design.

The enhancement at 900 mbar is attributed to the fast cooling of the hot plasma gas with surrounding colder gas, which leads to a reduction of CO recombination into CO_2 thus preserving the maximum conversion obtained in the resonator. The enhancement of the performance of the plasma torch with nozzle at atmospheric pressure is an important step towards industrial applicability of this technology.

Contacts:
Dr. Ante Hecimovic, ante.hecimovic@ipp.mpg.de
Prof. Ursel Fantz, ursel.fantz@ipp.mpg.de
Max Planck Institute for Plasma Physics, Garching, Germany

Source:
Journal of CO_2 Utilization **57** (2022) 101870, https://doi.org/10.1016/j.jcou.2021.101870

Comprehensive and Efficient CR Model for Ne-Ar Mixture Plasma Diagnostics

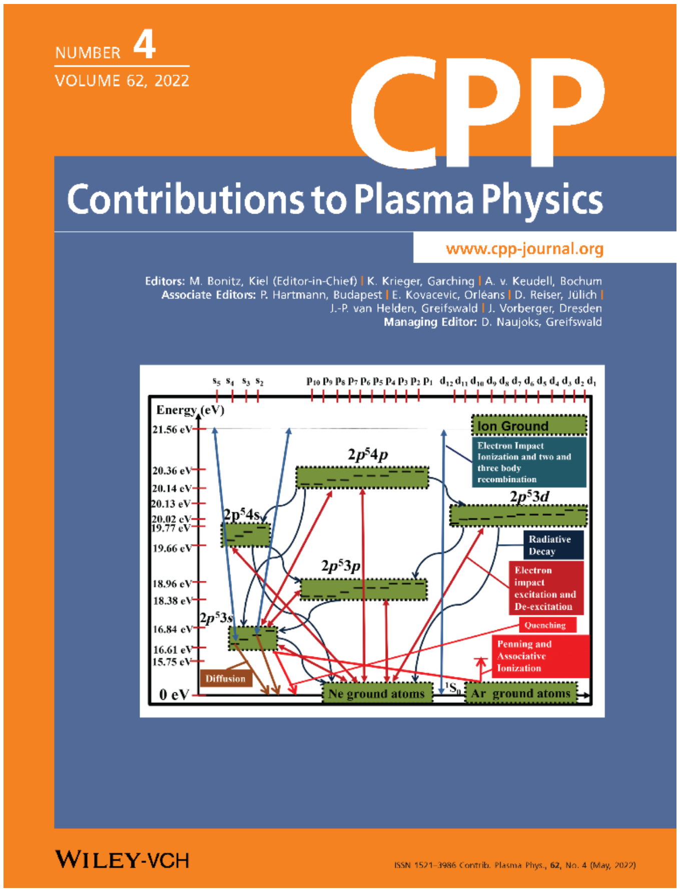


Figure 1. CR model framework for Ne-Ar plasma diagnostics (The image of CR model from our paper is published on the Cover Page of the journal *Contribution to Plasma Physics* **62**, Number 4, 2022)

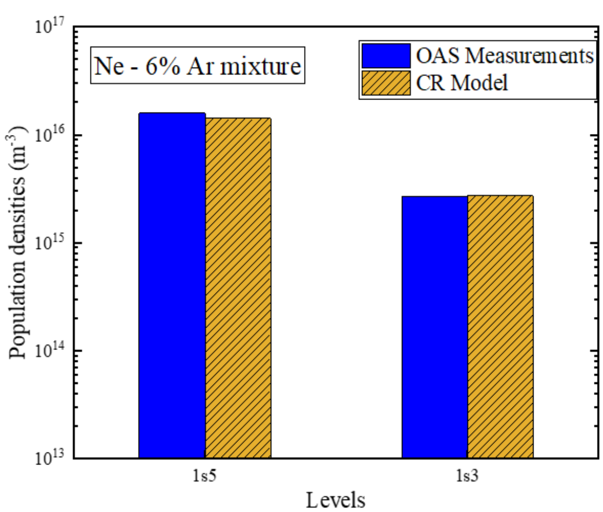


Figure 2. Comparison of metastable states ($1s_5$, $1s_3$) of neon obtained from OAS and CR model.

Rare gas mixture plasmas have applications such as increasing plasma thruster's ionization and streamer current in plasma jets. Accurate information about plasma parameters, such as electron temperature, electron density, and metastable populations, is essential for understanding plasma characteristics and improving efficiency. Optical emission or absorption spectroscopic (OES or OAS) measurements coupled with a Collisional Radiative (CR) model are an efficient diagnostic technique.

We have reported on a comprehensive CR model for diagnostics of Ne-Ar gas mixture plasmas. The CR model consists of 40 fine-structure levels of Ne. All of the essential population and de-population channels (electron impact excitation-de-excitation, ionization, two/three-body recombination, radiative decay, self-absorption correction, diffusion) were considered. The CR model was employed for the optical diagnostic of rf inductively coupled Ne–Ar mixture plasma. The plasma parameters (electron temperature, density) have been extracted by comparing the calculated values of the population of metastable levels ($1s_5$ and $1s_3$) of Ne from the CR model to their corresponding values obtained through OAS. Intensities of 23 emission lines ($2p_{i\,(i=1\text{-}10)} - 1s_{i\,(i=2\text{-}5)}$) of Ne were also compared with the earlier reported OES measurements. The non-Maxwellian electron impact excitation rates corresponding to some dominant transitions from the ground ($^1S_0$) and excited states ($1s_{i\,(i=2,5)}$) were also reported. Plasma parameters calculated from our CR model were in good agreement with the values obtained from OAS, OES, and Langmuir probe measurements.

Contacts:
Shubham Singh Baghel[1]
Prof. Reetesh Kumar Gangwar[2]
Prof. Rajesh Srivastava[1]
sbaghel@ph.iitr.ac.in, reetesh@iittp.ac.in
rajesh.srivastava@ph.iitr.ac.in
[1]Indian Institute of Technology Roorkee, India
[2]Indian Institute of Technology Tirupati, India

Source: Contrib. Plasma Phys. **62**, e202100226 (2022). https://doi.org/10.1002/ctpp.202100226

Review on Physics of Plasma Jets and Interaction with Surfaces

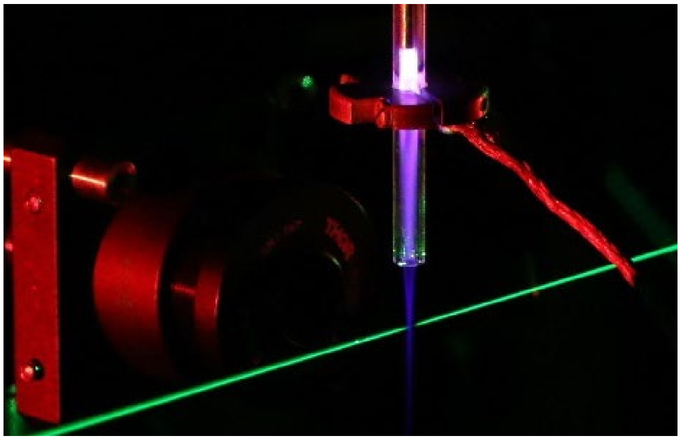


Figure 1. Photo of a helium plasma jet at Laboratoire de Physique des Plasmas (LPP), École Polytechnique, France.

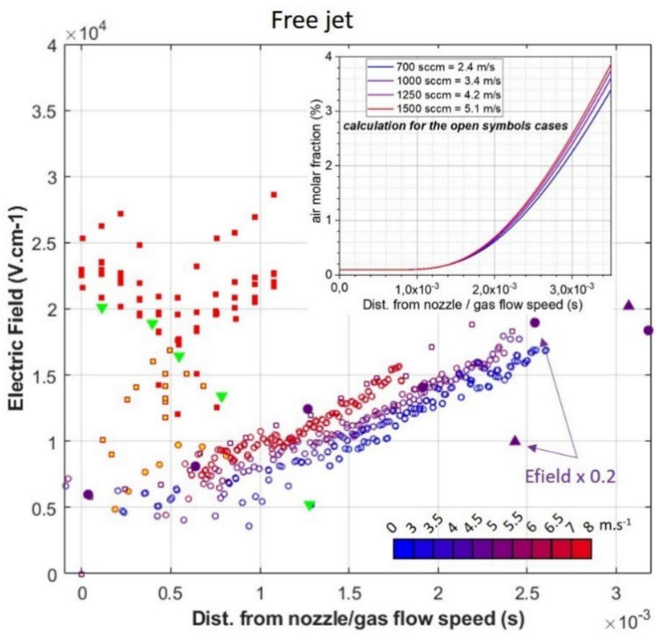


Figure 2. Collection of experimental values of electric field strength in freely expanding jets as function of the distance from the nozzle divided by the gas flow speed calculated at the exit of the nozzle. Data are taken from works using different powering voltage types and measurement techniques, in order to benchmark the measurements.

Plasma jets are sources of repetitive and stable ionization waves, meant for applications where they interact with surfaces of different characteristics. As such, plasma jets provide an ideal testbed for the study of transient reproducible streamer discharge dynamics, particularly in inhomogeneous gaseous mixtures, and of plasma–surface interactions.

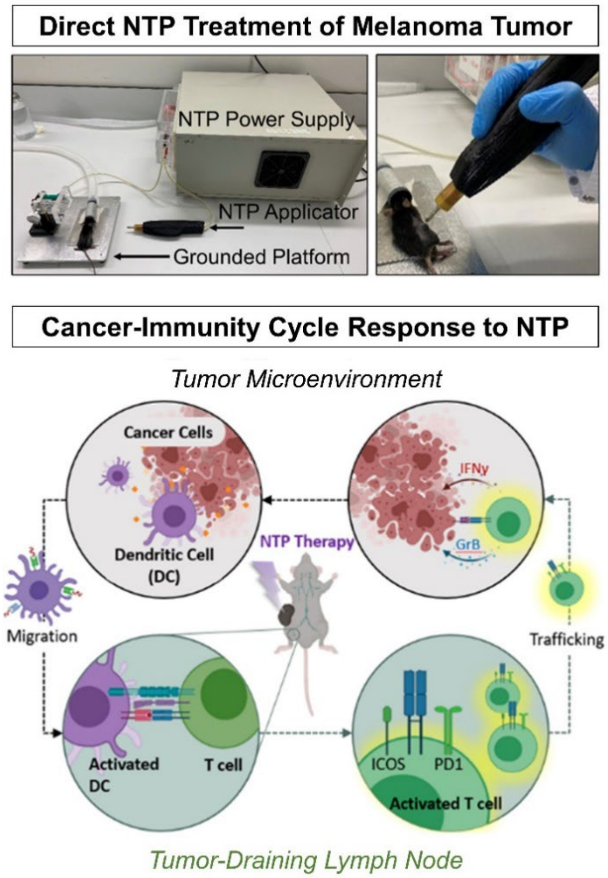
This topical review addresses the physics of plasma jets and their interactions with surfaces through a pedagogical approach. The state-of-the-art of numerical models and diagnostic techniques to describe helium jets is presented, along with the benchmarking of different experimental measurements in literature and recent efforts for direct comparisons between simulations and measurements.

This exposure is focussed on the most fundamental physical quantities determining discharge dynamics, such as the electric field, the mean electron energy and the electron number density, as well as the charging of targets. The physics of plasma jets is described for jet systems of increasing complexity, showing the effect of the different components (tube, electrodes, gas mixing in the plume, target) of the jet system on discharge dynamics. Focussing on coaxial helium kHz plasma jets powered by rectangular pulses of applied voltage, physical phenomena imposed by different targets on the discharge, such as discharge acceleration, surface spreading, the return stroke and the charge relaxation event, are explained and reviewed. Finally, open questions and perspectives for the physics of plasma jets and interactions with surfaces are outlined.

Contact:
Dr. Pedro Viegas
Masaryk University, Brno, Czech Republic
Instituto de Plasmas e Fusão Nuclear, Portugal
pedro.a.viegas@tecnico.ulisboa.pt

Source:
P. Viegas, E. Slikboer, Z. Bonaventura, O. Guaitella, A. Sobota and A. Bourdon. Accepted, Plasma Sources Sci. Technol.
https://doi.org/10.1088/1361-6595/ac61a9

The Effect of Local Non-Thermal Plasma Therapy on the Cancer-Immunity Cycle in a Melanoma Mouse Model



Direct treatment of melanoma tumors in mice with a microsecond-pulsed dielectric barrier discharge plasma stimulated various stages of the cancer-immunity cycle. A graphical summary highlighting the different aspects of the cancer-immunity cycle we investigated (in both the tumor micro-environment and tumor-draining lymph node) is provided.

Melanoma remains a deadly cancer despite significant advances in various therapies. The incidence of melanoma is also growing worldwide, which highlights the need for novel treatment options and combination strategies.

Here, we investigated non-thermal plasma (NTP) as a promising, therapeutic option. In a melanoma mouse model, direct treatment of tumors with a microsecond-pulsed dielectric barrier discharge plasma, resulted in reduced tumor burden and prolonged survival. Physical characterization of NTP treatment on the mouse revealed the deposited NTP energy and temperature associated with therapy response. Tumors were collected and whole transcriptome sequencing analysis identified several modulated pathways.

NTP treatment also enhanced the cancer-immunity cycle over time, as immune cells in both the tumor and tumor-draining lymph nodes appeared more stimulated to perform their anti-cancer functions. Thus, our data suggest that local NTP therapy stimulated systemic, anti-cancer immunity.

We discuss, in detail, how these fundamental insights will help direct the translation of NTP technology into the clinic and inform rational combination strategies to address the challenges in melanoma therapy.

Contacts:
Dr. Abraham Lin, abraham.lin@uantwerpen.be
Prof. Dr. Annemie Bogaerts, annemie.bogaerts@uantwerpen.be
University of Antwerp, Belgium

Source:
Bioengineering & Translational Medicine, e10314 (2022). https://doi.org/10.1002/btm2.10314

New Resources

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

Career Opportunities

- **Post-doctoral Position in the Field of Plasma Catalysis, Max Planck Institute for Plasma Physics (IPP), Garching, Germany**

We are looking for interested candidates for a postdoc vacancy at the Max Planck Institute for Plasma Physics, in the group of Plasma for Gas Conversion (application deadline is **June 7th 2022**). The group research focus is on the topic of plasma conversion of low-energy molecules into value-added chemicals by using low-temperature plasmas. Our research aims at advancing the current state of plasma technologies in the power-to-gas initiative, i.e. energy storage, hydrogen technology, and chemical energy carriers. We are looking forward to expand our activities and scientific expertise in plasma catalysis (dry methane reforming, ammonia synthesis, etc.) with microwave plasmas and dielectric barrier discharges (DBD).

We are looking for a candidate that would be responsible for the characterisation and development of plasma sources (predominantly DBD). It is expected that the candidate expand the current range of in-situ, in-vacuo, and ex-situ experiments for plasmas and materials surface characterization. The tasks of the successful candidate will include execution, evaluation and dissemination of the test results related to performance of plasma sources and implications for scientific advantage of plasma-catalysis. The candidate is required to have completed a doctoral thesis, preferably in the field of plasma physics, catalysis, or related fields. Experience with experimental techniques related to plasmas, gases and surfaces (e.g. OES, FTIR, XPS) is desired. Experience in the operation and characterization of plasma sources with background in atmospheric plasma research and/or DBD is of advantage. Strong abilities to interpret experimental data and to present complex scientific and technical matters fluently in English are required.

The duration of the position is 3 years and the desired starting date is 1st August 2022 or as soon as possible thereafter. The applicants should send a cover letter (including desired starting date), CV, and reprints of representative publications to the point of Contact:

Contact:
Prof. Ursel Fantz
Max Planck Institute for Plasma Physics, Garching, Germany
ursel.fantz@ipp.mpg.de

- **European Shock-Tube for High Enthalpy Research (ESTHER)**

The European Shock-Tube for High Enthalpy Research (ESTHER) is a new, state-of-the-art shock-tube facility funded by the European Space Agency (ESA) and tailored for supporting new European planetary exploration efforts. ESTHER is a facility of the Instituto de Plasmas e Fusão Nuclear (IPFN), an Associate Laboratory of Instituto Superior Técnico (IST). A significant effort has been placed by the funding agency (ESA) on developing state-of-the-art diagnostics capable of exploiting the full potential of the facility. A key aspect is a requirement for high-speed spectroscopy measurements outside of the usual visible spectral range, with an emphasis on the VUV (150-300 nm) and MWIR (2-5 micrometers) spectral regions. The budget for instrumentation roughly corresponds to half of the total budget allocated to the facility and includes two spectrometer + streak camera setups.

ESTHER is currently inviting expressions of interest (EoI) for a research contract with an institution affiliated to IST. The contract includes a career plan, with a probationary period of one year and a possible renewal up to 4 years, after which it is eligible for consideration of a tenure researcher position with IPFN/IST.

We are looking for highly qualified candidates, holding a PhD in Physics, Engineering Physics, or related scientific domains, who are able to propose, plan and execute a long-term research program for diagnostics using the ESTHER facility. The candidate selected should develop autonomous work, leading a small team responsible for the development of measurement techniques for ESTHER, and preparing and submitting applications for additional funding to the relevant funding agencies (national, EU, ESA, etc...) with the support of graduate students under her/his supervision.

The contract includes: (i) taking charge of the management and upgrading of the diagnostics of the ESTHER shock tube; (ii) defining new optical diagnostics in the IR region and identifying further spectroscopy diagnostics for ESTHER beyond optical emission spectroscopy (e.g. broadband/laser absorption spectroscopy, optical and electron interferometry, laser diagnostics, etc.); (iii) participating in the test campaigns on ESTHER, defining and deploying a test plan for spectroscopy, and developing adequate postprocessing tools for the analysis of measurements; (iv) participating in the scientific exploitation of the result obtained, in collaboration with the team experts on numerical modelling of high-speed shock-waves nonequilibrium kinetics and radiation process.

Applicants can submit their **EoI** by sending:

- Motivation letter (max 1 page)
- Curriculum vitae (max 5 pages)
- Brief research statement (max 2 pages)
- Contact (including email address) of three researchers or professionals who can be contacted to provide reference letters, attesting to the scientific and professional qualities of the possible candidate.

Applications or questions must be submitted in electronic form, **by June 30, 2022** (message subject: "EoI ESTHER") to:
Dr. Mário Lino da Silva, PI ESTHER, mlinodasilva@tecnico.ulisboa.pt

- **Post-doctoral Position in Innovative Insect Pest Management, University of California, USA**

We are seeking postdoctoral candidates for a vacant full-time position to be hosted at University California Davis, USA. The incumbent will be part of a multi-disciplinary research team devoted to develop and promotion of innovative and highly complementary technologies to improve insect pest management and sustainable crop production. Moreover, we work with hyperspectral imaging (machine vision), robotics (rail systems to control movement of imaging systems and/or pesticide spraying equipment), phone app development (for quality control of pesticide spray coverages), lighting (use of LED to control pests and manipulate their behavior). More information about our research can be found on the following website: http://chrnansen.wix.com/nansen2.

Low and inconsistent seed germination and seedling vigor are major bottlenecks in production of many specialty crops, including greenhouse ornamental and vegetable plugs (seedlings). Production practices promoting seed germination and seedling vigor are of particular importance to organic producers, who have higher disease and pest pressures and considerably fewer options available in terms of synthetic fertilizers and pesticides. Recent scientific studies show that cold plasma treatments can significantly increase seed germination percentage, elicit earlier germination and therefore reduced production costs, and significantly increase seedling vigor due to better growth and suppression of seed pathogens. The California Department of Food and Agriculture, in collaboration with four institutions in four US states [University of California Davis, University of Minnesota, University of Maryland, and Cornell University], plan to demonstrate and disseminate solutions to enhancement of seedling plug productions and of pest and disease management through optimized cold plasma treatments of specialty crops seeds. Systems to perform cold plasma treatments of large samples of seeds are commercially available and cost-effective, so outcomes from this project can be readily adopted by specialty crop producers.

We are seeking highly qualified candidates within a rather broad spectrum of qualifications, but the following are considered essential requirements: 1) track-record of publications in internationally recognized and peer-reviewed research journals, 2) track-record of in-depth knowledge about experimental designs in research studies, 3) track-record of experience with statistical data analyses and basic programming in R or similar software packages, and 4) track-record of being involved in complex research and ability to solve practical and/or theoretical challenges.

Application and accompanying resume should be emailed to:

Associate Professor Christian Nansen
University of California, Davis, USA
chrnansen@ucdavis.edu

- **Research Engineer / Post-doctoral Researcher, Computational and Theoretical Modeling of Low-temperature Plasma Dynamics, Stanford University, USA**

The Plasma Dynamics Modeling Laboratory (PDML) in the Department of Aeronautics and Astronautics at Stanford University is seeking a Research Engineer or a Postdoctoral Research Fellow. The position is focused on development of computational and theoretical models to understand the physics of low-temperature plasmas (such as plasma-material/surface int eraction, plasma chemistry, plasma instabilities, plasma turbulence, etc) in space propulsion, cross-field discharges, high-power microwave sources, and plasma processing systems.

The researcher must have a Ph.D. degree in Physics or Engineering, with a particular focus in plasma science, rarefied gas dynamics, computational fluid dynamics, or closely related fields. Expertise in developing kinetic (particle- and grid-based), fluid (drift-diffusion, moment, etc), or data-driven models, preferably with experience in high-performance computing, is strongly desired. Highly motivated and hardworking candidates with a strong background in computational plasma and fluid dynamics are encouraged to apply.

More information about the research group is available at https://pdml.stanford.edu/

The initial appointment period is 1 year with a reappointment for 2 or 3 years upon availability of funds and subject to performance.

Applicants are invited to send a resume/CV, including a list of publications, a brief statement of research interests, and contact information of three references to:

Prof. Ken Hara
Stanford University, USA
kenhara@stanford.edu

- **Plasma Scientist/Engineer, Lam Research, Tualatin, Oregon, USA**

Lam Research is seeking a plasma scientist/engineer to develop next-generation plasma reactors for plasma enhanced chemical vapor deposition (PECVD) and plasma enhanced atomic layer deposition (PEALD). The candidate will be responsible for conducting fundamental research and transferring scientific principles to industrial products.

- Conduct literature search and determine the direction of the next-generation plasma reactors and related technologies.
- Create conceptual designs, builds the prototypes, characterizes the fundamental reactor properties, and proves the design concept in a timely fashion.

- Lead other engineers to convert the prototype reactors into the industry-scale production tools.
- Attend conferences and tradeshows to maintain a close relationship with experts in academia to learn the state-of-the-art technology.
- Understand requirements, roadmaps, cost, and business challenges our customers are facing and reflects those into the plasma reactor development roadmap.

Minimum qualifications
- Ph.D. in Physics or Engineering (Chemical, Electrical, Mechanical or related fields) with 1-3 years of related work; or Master's degree in those fields with +6 years of relevant work experience.
- Educational background or work-related experiences in non-equilibrium low-temperature plasmas.

Preferred qualifications
- Expertise in plasma source development, including but not limited to CCP, ICP, MW, and SW plasmas.
- Proficiency in plasma diagnostics and automated data collection and analysis.
- Problem-solving and trouble-shooting skills.
- Ability to work independently in a highly dynamic and fast-paced environment.
- Ability to effectively communicate with colleagues in cross-functional team environment.

Contact:
Dr. Yuki Sakiyama
Lam Research Corporation, USA
yukinori.sakiyama@lamresearch.com

- **Post-doctoral Research Fellow, Computational Low Temperature Plasmas, University of Michigan, USA**

A post-doctoral research fellow (PDRF) position in computational low temperature plasmas (LTPs) is available in the research group of Prof. Mark J. Kushner at the University of Michigan, Ann Arbor, MI USA. The position entails development and application of computer models for low temperature plasmas, plasma chemistry and plasma surface interactions; and nano-scale modeling of surface evolution. The PDRF may work on several projects, examples being:

- Atmospheric pressure plasma transport, plasma chemistry and sources.
- Atmospheric pressure plasmas interacting with complex surfaces, liquids, biological materials, and electrochemical solutions.
- Low pressure plasma transport and chemistry in inductively coupled, microwave and capacitively coupled plasmas.
- Plasma surface interactions for materials process.
- Profile evolution for microelectronics fabrication.

The PDRF should have the following skill-sets:

- Expertise in the fundamental processes of LTPs, plasma chemistry and plasma surface interactions.
- Expertise in developing and maintaining parallel computer models for LTPs using high level languages.
- Excellent oral and written communication skills.
- Ability and desire to supervise graduate students; and interact with research colleagues in academia, national laboratories and industry.

More information about the research group is at: https://uigelz.eecs.umich.edu.

The initial appointment period is 1 year with reappointment for 2 or 3 years subject to performance and availability of funds. The position is available immediately and requires in-person presence in Ann Arbor, Michigan. (The position is not available remotely.)

Applicants should send a cover letter (including date applicant is available), CV, reprints of representative publications and contact information for 3 references to **Prof. Kushner** (mjkush@umich.edu).

Contact:
Prof. Mark J. Kushner
University of Michigan, USA
mjkush@umich.edu

Collaborative Opportunities

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

Disclaimer

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