The Newsletter of the International Low Temperature Plasma Community (ILTPC)

Issue 50
May 30, 2025

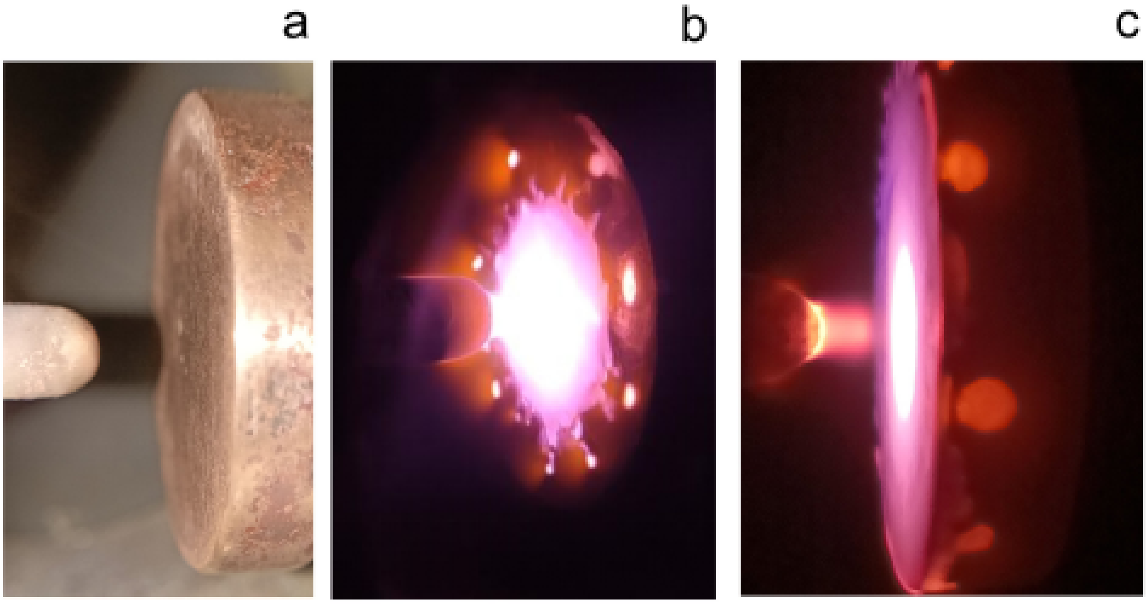
Call for Contributions

Please submit content for the next issue of the Newsletter. Please send your contributions to **editor@iltpcnewsletter.org** by June 27, 2025. Please send contributions as MS-Word files (***.docx**) if possible. In particular, please send Research Highlights and Breakthroughs using **this template**. You can also directly download the template in docx format **here**. (Please do **not** send files in doc format.)

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 The topic can be anything you want - a recently published work, a new unpublished result, a proposed new area of research, company successes, anything LTP-related. When submitting a highlight, please provide information in the submission Email that justifies classification as a highlight. Criteria are: in a Highlight, the results or the approach should be surprising, of extraordinary quality, and should have impact beyond the submitting team.

Images to Excite and Inspire

Please send your images (with a short description) to editor@iltpcnewsletter.org. The recommended image format is TIF, JPG, or PNG. The minimum file width is 800 px.



Current spots in DC atmospheric pressure glow discharge in helium

For more information, please contact:
Associate Professor Aliaksandra Kazak
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LTP Perspectives: Policy, Opportunities, Challenges

Please submit your notices for LTP Perspectives to editor@iltpcnewsletter.org.

Leaders of the LTP Community: Career Profiles

Please submit your notices for Leaders of the LTP Community to editor@iltpcnewsletter.org.

Plasma Science Education

Please submit your notices for LTP Plasma Science Education to editor@iltpcnewsletter.org.

Large Language Models, AI and Order of Magnitude Estimates

Mark J. Kushner, University of Michigan (USA), mjkush@umich.edu

Perhaps the most disruptive event in decades of plasma science education is the emergence of large language models (e.g., ChatGPT), machine learning and artificial intelligence (LLM/ML/AI). In discussions with dozens of academic colleagues, it seems that no university has a unified policy for how LLM/ML/AI will best be used in higher education. We collectively need to come to a consensus on how we leverage LLM/ML/AI in plasma science education. That consensus should not come at the expense of mastering the fundamentals of the field and instilling the ability to make back-of-the-envelope, order-of-magnitude estimates.

Early in my career I worked at a company that designed and built plasma excited high energy laser systems. My boss, JJ Ewing, was an expert at making order-of-magnitude estimates to determine if a new concept had any hope of working or delivering on what we promised. JJ would go to the chalkboard and within minutes sketch the system and apply order-of-magnitude estimates at every juncture – the transmission of the electron beam through the foil, the W-value for ionization, the electron temperature, the laser absorption coefficient. JJ was able to make go- or no-go decisions on pursuing new concepts based on making these order-of-magnitude estimates. JJ's ability to make order-of-magnitude estimates resulted from his mastery of the fundamentals.

In classical physics, there are only a few fundamental equations that govern much of what we do. There is Boltzmann's equation, whose moments give us mass, momentum and energy equations, and there are Maxwell's equations. Not so distant extensions of these equations are fundamental concepts and scaling laws, such as elastic vs inelastic collisions, and Langevin rate coefficients. I learned from JJ the enormous importance of mastering the fundamentals of the discipline – these equations and their extensions. By mastering these fundamentals you could then make back-of-the-envelope, order-of-magnitude of estimates of nearly any process in low temperature plasmas.

Before LLM/ML/AI, we started on the path to making order-of-magnitude estimates by first mastering the fundamental principles of the field. This mastery was acquired by working through problems that illustrate fundamental concepts – drift and diffusion, ambipolar fields, sources-balancing-losses, E/N. With LLM/ML/AI, those fundamental equations, concepts and scaling laws are on the other side of a wall of neural-networks. LLM/ML/AI provides answers without the need to make estimates. If we have faith in the technology, we accept these answers without making order-of magnitude estimates to verify whether they are reasonable. Without the need to make order-of-magnitude estimates, the need to master the fundamentals will fade.

So this is our challenge. How do we incorporate the power of LLM/ML/AI into an LTP curriculum while still emphasizing (and requiring) mastery of the fundamentals, and instilling the skill of making back-of-the-envelope, order-of-magnitude of estimates?

The ability to make back-of-the-envelope, order-of-magnitude estimates is the single most important skill a researcher can develop. To gain that skill, your education needs to be based on fundamentals. We need to make certain that using LLM/ML/AI in plasma science education enhances that ability and does not diminish it.

General Interest Announcements

Please submit your notices for General Interest Announcements to editor@iltpcnewsletter.org.

Meetings, Online Seminars, and Schools

Please submit your notices for Meetings and Online Seminars to editor@iltpcnewsletter.org.

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

Co-Chairs:
Prof. Andrei Smolyakov, The University of Saskatchewan
Prof. Eva Kovacevic, Université d'Orléans

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.
Nominations for future speakers scheduled for November 2024 to April 2025 can be submitted through this page until September 13, 2024.

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Prof. Quan-Zhi Zhang
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Community Initiatives and Special Issues

Please submit your notices for Community Initiatives and Special Issues to editor@iltpcnewsletter.org.

Plasma and Agriculture III

Submission deadline:
Friday, 31 October 2025

Website:
https://onlinelibrary.wiley.com/page/journal/16128869/call-for-papers/si-2025-000532

Global agriculture faces unprecedented challenges related to the rapid demographic growth, climate change, biotic stress that causes major economic losses and the negative impact on the environment leading to resource degradation. To address these pressing concerns, innovative technologies are key priority triggers towards promising solutions that can enhance food security, sustainability and resilience of agrifood systems, and environmental protection. During the last three decades, extensive research efforts have been directed to non-thermal plasma-based approaches, evidencing the potential of plasma to activate various biological mechanisms in plants.

After two successful special issues on plasma agriculture in 2018 and 2021, Plasma Processes and Polymers proposes a new collection dedicated to this fast-growing research field, to expand the discussion of novel findings and developments, highlighting groundbreaking advancements, and to identify new directions with potential for applications.

Topics for this call for papers include but are not restricted to:

- **Plasma treatment of seeds and plants for enhanced productivity**, including direct treatment or indirect one, by exposure to plasma treated gas or plasma activated water (PAW). Articles should go beyond the mere description of the effects on seed germination and plant growth and vigor, attempting to correlate such measurements with plasma diagnostics or PAW characterization, and discuss mechanisms involved in plant response to plasma exposure. We also welcome long-term monitoring of plants in field trials, allowing the assessment of productivity and yield under real environmental conditions. Studies focusing on the role of plasma treatment in inducing tolerance to abiotic stress (including drought, extreme temperatures, salinity, etc.) are also expected. A theme of great interest is the plasma stimulation of plant secondary metabolite biosynthesis, due to the high value of these natural compounds in various industries.

- **Mitigation of biotic stress through plasma treatment**, essential for crop resilience and quality, includes exploring plasma-driven pathogen control to reduce seed-borne, foliar and root diseases caused by fungi, bacteria and viruses. Works emphasizing the role of plasma in the activation of plant defense response are also of high importance to clarify the existing hypotheses. Another subject of interest is the elimination or reduction of insect pests that produce serious damage to crops and stored products, together with the discussion of relevant mechanisms of plasma action.
- **Post-harvest management using non-thermal plasma** is another key focus, specifically dedicated to the preservation of stored agricultural products quality, extending shelf-life, and controlling microbial spoilage in seeds, fruits and vegetables, etc. We expect articles dealing with direct or indirect plasma treatment of various solid and liquid foods, and of food packaging materials. Papers discussing the preservation of original nutritional and sensory characteristics are welcome.
- **Plasma remediation of soil and water** to diminish the environmental impact of agriculture includes plasma-based solutions to agriculture-specific contamination. We invite articles devoted to plasma treatment of soil and water, aimed at the removal of frequently detected agricultural pollutants, such as pesticides, heavy metal ions, veterinary pharmaceuticals and various pathogens from farming, etc. Works examining beneficial effects of plasma on soil for fertility enhancement, microbial community dynamics, and plant-microbe interactions are also of interest.

Guest Editors:
Prof. Thierry Dufour
Sorbonne University
France
Dr. Monica Magureanu
National Institute for Laser Plasma and Radiation Physics
Romania

New Resources

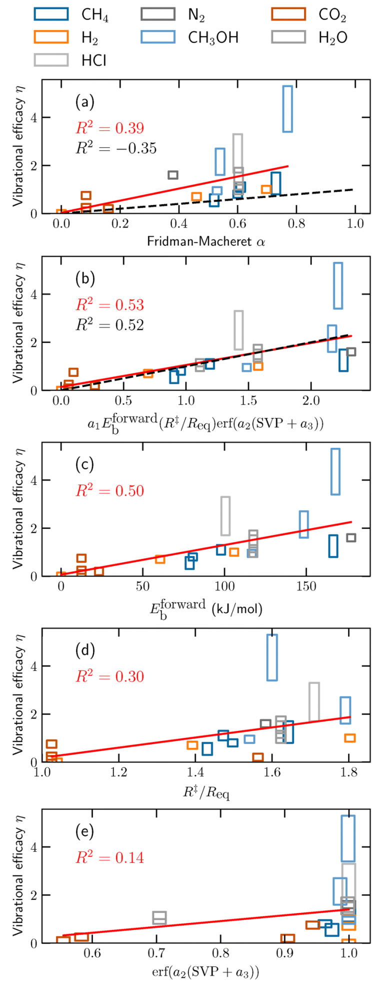
Please submit your notices for New Resources to editor@iltpcnewsletter.org.

Research Highlights and Breakthroughs

Please submit your notices for Research Highlight and Breakthroughs to editor@iltpcnewsletter.org.

Vibrationally excited molecule-metal surface reactions in heterogeneous and plasma catalysis: going beyond the Fridman-Macheret α model

Plasma catalysis has the potential to convert (green) electricity into valuable chemical products with high efficiency. Unfortunately, for this technology to become mature, a considerable amount of research is still required. For example, the ionized plasma can induce many different changes in both the reactants and the catalyst. One such effect is the vibrational excitation of reactants, which boosts reactivity in heterogeneous and plasma catalysis by mainly affecting key rate-determining steps. To account for this, current microkinetic models often use the Fridman–Macheret α approach. While common in plasma catalysis simulations, its accuracy is unclear. In this study, we compare the Fridman–Macheret α method with vibrational efficacies from molecular dynamics simulations in literature. The results show poor agreement, casting doubt on the method's suitability for describing vibrationally excited reactions on metal surfaces. We propose an alternative model that, at a similar computational cost but with considerable improvements, uses three physical fingerprints of the reaction: (1) the dissociative chemisorption barrier height, (2) the barrier's "lateness", and (3) the overlap of vibrational modes with the reaction coordinate at the barrier. We recommend adopting this new model, as it can be easily used in existing microkinetic models for heterogeneous and plasma catalysis.



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Source:

Energy & Environmental Science Catalysis 2025. https://doi.org/10.1039/D5EY00062A

Noteworthy Papers

Please submit your notices for Noteworthy Papers to editor@iltpcnewsletter.org.

Characterization of interstellar carbon dust analogues synthesized by dielectric barrier discharge and evolution after irradiation with 3 MeV H^+

Ioana Cristina Gerber, Ilarion Mihaila, Valentin Pohoata, Andrei Sandu, Catalin Agheorghiesei, Laurentiu Valentin Soroaga, Decebal Iancu, Radu Florin Andrei, Ion Burducea, Mihai Straticiuc, Dumitru Duca, Dmitrii Egorov, Yvain Carpentier, Bertrand Chazallon, Alessandro Faccinetto, Nicolas Nuns, Cristian Focsa, Claire Pirim, Ionut Topala
Monthly Notices of the Royal Astronomical Society 538, 1, 266 (2025)
https://doi.org/10.1093/mnras/staf314

Hydrogenated amorphous carbon (a-C:H) with a fluffy morphology was synthesized via nanosecond-pulsed dielectric barrier discharge in a helium–butane plasma. Characterization by microscopy, mass spectrometry, and spectroscopy showed that its infrared features match those of carbonaceous dust in galaxy IRAS 08572+3915. The material consists of a hydrogen-rich aliphatic network with isolated aromatic regions. Proton irradiation (3 MeV) induced dehydrogenation and graphitization, shifting the material's properties toward those of the astronomical dust. Decay of the 3.4 μm band with fluence allowed calculation of CH destruction cross-sections, linking cosmic ray exposure to the spectral evolution of interstellar dust.

Selective catalytic hydrogenation of C2H2 from plasma-driven CH4 coupling without extra heat: mechanistic insights from micro-kinetic modelling and reactor performance

Eduardo Morais, Fabio Cameli, Georgios D. Stefanidis and Annemie Bogaerts
Energy Environm. Sci. Catalysis, 2025,3, 475-487
https://pubs.rsc.org/en/content/articlelanding/2025/ey/d4ey00203b

We study the selective catalytic hydrogenation of C_2H_2, main product from non-oxidative CH_4 coupling in gas-phase plasmas, to C_2H_4, a cornerstone of the global chemical industry, by experiments and temperature-dependent micro-kinetic modelling. The model is validated against new experimental data from a nanosecond pulsed plasma reactor integrated with a downstream catalytic bed consisting of Pd/Al_2O_3. We explore the effects of varying Pd loadings (0.1, 0.5, and 1 wt%) on the catalyst activity and the C_2H_4/C_2H_6 product distribution. Consistent with the experimental data, our surface micro-kinetic model shows that while higher Pd loadings lower the catalyst activation temperature for C_2H_2 conversion, they also induce over-hydrogenation to C_2H_6 at lower temperatures and increase oligomerisation in the experiments, which are detrimental to the C_2H_4 yield. The model also elucidates reaction mechanisms and pathways across different temperature regimes, expanding our understanding of the hydrogenation process beyond the experimental range. Besides highlighting the importance of optimising the metal loading to balance C_2H_4 and C_2H_6 selectivity, our findings demonstrate the effective implementation of post-plasma catalysis using a simple catalyst bed heated by hot gas from the plasma region. This study opens possibilities for testing different plasma sources, catalysts, gas flow magnitude and patterns, and catalyst bed-to-plasma distances.

Plasma catalysis: what is needed to create synergy?

Joran Van Turnhout, Kevin Rouwenhorst, Leon Lefferts, and Annemie Bogaerts
Energy Environm. Sci. Catalysis, 2025
https://pubs.rsc.org/en/content/articlehtml/2025/ey/d5ey00027k

Plasma catalysis is gaining increasing interest for various applications, for air pollution control and for sustainable chemistry. The first application field is already at high technology readiness level (TRL), with commercial devices available for many years, especially for VOC removal, the main metric being conversion of VOCs, rather than energy efficiency. In contrast, the second application field is at much lower TRL, and still faces several challenges, such as limited energy efficiency, limited product yield, and limited product selectivity. The main reason is that the underlying mechanisms are far from understood. Indeed, while plasma–catalyst synergy is often reported, in other cases it is not observed. Hence, there is a need for better insights into the current limitations, and especially how to overcome them, in order to make significant progress in this emerging research field.
In our new perspective paper, we aim to identify the critical limitations in the field of plasma catalysis for sustainable chemistry applications. We believe the main limitations are: (i) lack of insight in the optimal catalyst material tailored to the plasma environment, leading to trial-and-error experiments often based on insights from thermal catalysis, (ii) the plasma conditions not being tuned to the catalyst needs and thereby suboptimal plasma activation of molecules, (iii) the need for improved plasma reactor design with better contact between plasma and catalyst, (iv) the needs for correct measurements and consistent reporting of the obtained results, and (v) energy losses via the backward reactions, both thermo-catalytic as well as plasma-enhanced, and related to this, the need to think out of the box. Where possible, we make suggestions on how to solve these critical limitations.

Career Opportunities

Please submit your notices for Career Opportunities to editor@iltpcnewsletter.org.

Postdoc position at CWI (Amsterdam)

Job description

Switchgear and other high-voltage equipment currently often operate with SF6 gas, which is the worst greenhouse gas known. Within the Green Sparks project, we investigate electric discharges in alternatives to SF6. For further information, see https://homepages.cwi.nl/~ebert/2023-ERCIM-News.pdf

We are seeking a postdoc to develop computational models of electrical breakdown of gases. Breakdown occurs in several stages: streamer discharges form, some of them can turn into leaders due to gas heating, eventually resulting in a spark. Simulating all these stages in detail is computationally unfeasible, so the goal is to develop a simplified model focusing on the leader stage. You will:

- Analyze experimental data and microscopic simulations
- Identify relevant physical features and parameters
- Apply machine learning techniques to build predictive models
- Collaborate closely with experimentalists and modelling experts

Project Environment

This position is part of a collaborative research project involving:

- PhD students and a postdoc at TU Eindhoven, conducting experiments
- A PhD student at CWI, focused on modelling streamer discharges
- A committee of industrial users, ranging from start-ups to multinationals, providing feedback several times per year

Our modelling group at CWI Amsterdam has extensive expertise in modelling the dynamics of gas discharges. Experimental partners at TU Eindhoven include the group of Sander Nijdam, an expert in measuring streamer discharges with highest resolution, and the group of Tom Huiskamp, who focuses on new solid state high voltage sources and their applications.

Requirements

- Previous experience with electric discharges, either experimental or computational
- Affinity for computer simulations
- A finished PhD thesis (at least submitted to the PhD committee by the time you start)

The position is for 20 months. There might be opportunities to continue afterwards in a related project.

Link for applications: https://www.cwi.nl/en/jobs/vacancies/1161531/

Contact:
Prof. Dr. Ute Ebert and/or **Dr. Jannis Teunissen**
CWI, Amsterdam
Ute.Ebert@cwi.nl and/or Jannis.Teunissen@cwi.nl

Postdoctoral position
Pontificia Universidad Catolica de Chile

We are looking for a highly motivated postdoctoral researcher to join the experimental team in our plasma laboratory. The selected researcher will collaborate on in-house experiments and diagnostics to study plasma-liquid interactions, as well as their effects on the selective production of different reactive oxygen and nitrogen species (RONS) relevant for electrochemical synthesis.

Responsibilities:

- Contribute to the design and commissioning of gliding arc and/or DBD plasma reactors to optimize the selective generation of RONS relevant for electrochemical synthesis.
- Perform hands-on experimental work related to plasma-liquid interactions and associated diagnostic techniques, including absorption and emission spectroscopy, electrical characterization, fast imaging, amongst others.
- Participate in discussion of results with both plasma physics and electrochemical research teams.
- Prepare and contribute to the writing of scientific manuscripts for submission to peer-reviewed journals

We are looking for candidates with the following characteristics:

- PhD in physics, (electrical) engineering or a related field.
- Practical experience in hands-on experimental (plasma) physics and/or electrical discharges.
- Knowledge of high voltage equipment, associated safety practices and different diagnostics techniques.
- Collaboration and presentation skills in spoken and written English. Knowledge of Spanish is not mandatory, but considered an asset.

How to apply:
Please send your application including the following documents to Prof. Felipe Veloso (fveloso@uc.cl):

- Motivation letter
- Curriculum vitae
- List of publications, indicating which articles you are first- or corresponding- author
- Contact details of (at least) two referees who have directly worked with you.

About us:

Pontificia Universidad Católica de Chile is a leading research institution, ranked among the top 100 universities globally in the 2025 QS World University Rankings and consistently placed among the top three in Latin America. The Plasma Physics Group at the Institute of Physics has been active for nearly 40 years, publishing over 150 papers in refereed journals and maintaining several international collaborations.

For further information, please contact Prof. Felipe Veloso at fveloso@uc.cl

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PhD position at the University of Trento: Plasma-assisted valorization of biomethane and biogas

Plasma-assisted decomposition of biomethane and biogas, when powered by renewable energy sources, is an environmentally friendly process that can be viewed as a cost-effective method for producing CO2-free hydrogen. The project aims to develop and test a plasma reactor to facilitate the thermal cracking of methane and the CO2 dry reforming process. The Ph.D. student will characterize the process to understand and optimize the production mechanisms of valuable products (e.g., H2).

We are looking for a talented and motivated student with a background in experimental physics or chemical physics. She/he should have a strong attitude toward teamwork and problem-solving.

More information and the application process can be found at the following link:
https://molecular.physics.unitn.it/phd-position-available-at-fam-lab/

Contact:
Luca Matteo Martini
University of Trento, Department of Physics
luca.martini.1@unitn.it

Deadline: 12 June 2025, 4:00 pm CET.

Collaborative Opportunities

Please submit your notices for Collaborative Opportunities to editor@iltpcnewsletter.org.

Disclaimer

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