International Low Temperature Plasma Community

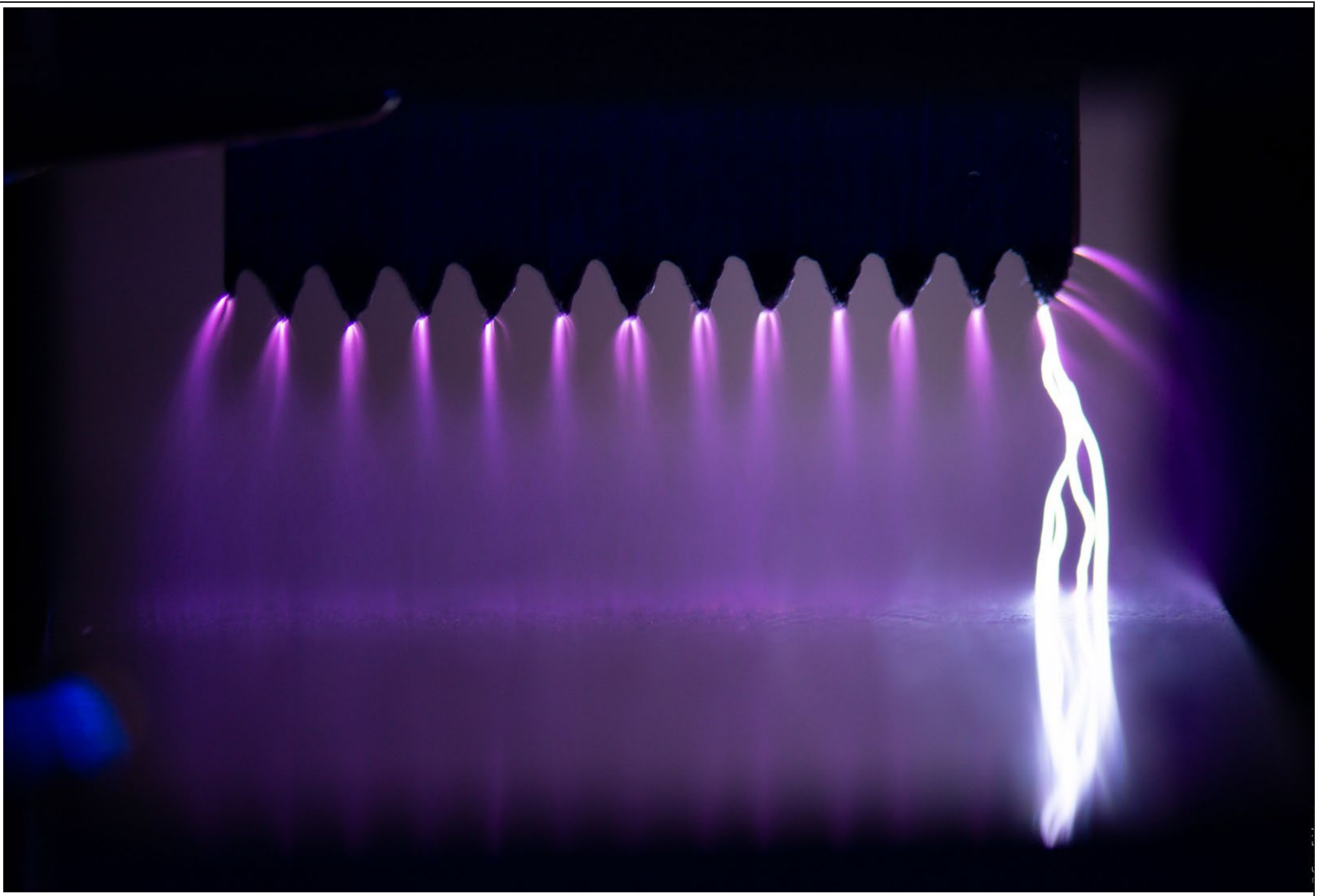
https://mipse.umich.edu/iltpc.php, iltpc-central@umich.edu

Newsletter 37

20 December 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.



Multiple Streamers and Sparks: The image shows a pulsed corona discharge in room air (50% relative humidity, 22 ºC). The top electrode (HV) is a stainless steel saw blade ~7 cm long. The bottom electrode (ground) is a polished stainless steel plate. The inter-electrode distance is ~2 cm. The discharge is produced by voltage waveform of 10 kHz, positive square wave with 2 µs pulse at half-maximum. When the applied voltage exceeds 30 kV (shown: 37 kV), a spark is occasionally observed at seemingly random frequencies and locations (~0.1–3 Hz). **Dr. Greg Fridman,** AAPlasma LLC, USA, greg@aaplasma.com.

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• Call for Contributions	• Community Initiatives, Special Issues
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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 **January 19, 2024.** 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 The topic can be anything you want - a recently published work, a new unpublished result, a proposed new area of research, company successes, anything LTP-related.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

Collaborative Low Temperature Plasma Research Facilities: From a Pilot Concept to Impactful Operation

In 2019, the US Department of Energy, Fusion Energy Sciences established two Low Temperature Plasma (LTP) Collaborative Research Facilities (CRFs) at the Princeton Plasma Physics Laboratory (PPPL) – Princeton Collaborative Research Facility (PCRF, https://pcrf.pppl.gov) – and at Sandia National Laboratories (SNL) – Sandia Plasma Research Facility (PRF, https://www.sandia.gov/prf/). The primary difference between these CRFs and traditional plasma science centers is that the CRFs run open-to-all, broad-based, external user programs in which the facility expertise and resources are allocated based on an independent merit review of research proposals. Both CRFs allocate at least 50% of their funded time to support these user programs. The remaining budget is allocated to the research performed by facility staff to advance facility capabilities and expertise.

Both PCRF and PRF provide users with free-of-charge access to advanced diagnostics of plasmas, plasma-surface interactions, and nanoparticles, and advanced computational codes to simulate a broad range of plasma conditions and interactions. PPPL and SNL developed and accumulated these resources over many years of support from government sponsored programs and are now able to provide these capabilities to the scientific community through the CRFs. Such a broad scope of resources is rarely available at individual universities, within industry, and even other national labs. Add in well-developed infrastructures, high safety culture of the national labs, and experience in running user facilities – and the PCRF and PRF are able to serve a diverse community of plasma users including faculty, lab and industry scientists, postdocs and students, experienced and earlier career researchers, physicists, engineers, biologists, chemists, and medical doctors.

At the time of the inception of the CRFs, the National Academies of Science and Engineering published its Decadal Assessment of Plasma Science (https://nap.nationalacademies.org/catalog/25802/plasma-science-enabling-technology-sustainability-security-and-exploration). The report was receptive to the CRF concept as a pilot project. After four years of operation, the total number of submitted proposals to both facilities stands at

310 with 40-50% highly ranked by the independent review panels and awarded facility runtime. This high demand suggests a broad acceptance of the CRF concept by the LTP community.

From the PCRF side, priority is given to seed user projects and to high risk proposals, not mature enough for full independent funding. The total number of PCRF user projects has reached 88, with 80% of these projects either completed or in progress. The scope of user projects, including experimental and computational, has ranged from LTP science to plasma applications in semiconductor fabrication, synthesis of nanomaterials, quantum systems, aerospace, medicine, sustainability and catalysis.

More than 30% of all PCRF projects are led by female or underrepresented minority PIs. About 30% of project PIs are earlier career researchers, and a growing number of PIs are not from primarily research-driven institutions. The PCRF researchers provide expert professional assistance throughout the collaboration from preparing the initial proposal to applying for continuing funding at the project's conclusion. We are also actively engaged in training users in plasma diagnostics, software and data analysis as well as providing our own expertise in plasma science to analyze results and identify significant conclusions. This approach has resulted in a total of 51 publications, with many more submitted or in preparation. Through its unique approach, the PCRF has enabled new science, catalyzed scientific careers, and inspired students to pursue scientific research.

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Leaders of the LTP Community: Career Profiles

Dr. Bogdana Mitu – Leading Innovation in Plasma Synthesis of Materials

Dr. Bogdana Mitu is senior scientist 1st degree at the National Institute for Laser, Plasma and Radiation Physics (INFLPR) in Bucharest, Romania. Graduating from the Faculty of Physics at the University of Bucharest in 1997, she embarked on her initial foray into experimental work in the Low Temperature Plasma Physics Department of the Institute during her student years. She received her PhD degree in Exact Sciences, Physics, with *Summa cum laude* distinction in 2003. Notably, from these formative years, she has been actively utilizing laser and plasma techniques to advance the development of innovative processes and materials, a trend followed all along her scientific path.

Bogdana's professional journey has been intricately linked to the plasma synthesis of carbon-based materials. From various types of plasma polymers, ranging from parylene to conductive polymers, fluoropolymers, nanocomposites seamlessly integrating polymers with metallic nanoparticles, and, more recently, biopolymers, she has developing a multitude of processes at both low and atmospheric pressure involving plasma polymerization in various configurations. Complementing her materials studies, Bogdana has delved into plasma diagnostics. Through meticulous investigations using mass spectrometry and optical emission spectroscopy, she has successfully unveiled crucial parameters and underlying processes that enable precise synthesis control. In 2012 she earned, together with the colleagues working on the topic, a prestigious Romanian Academy prize, for outstanding contributions to the synthesis and characterization of nanometric carbon wall-type graphene structures.

Since 2021, Bogdana has served as a member of the Editorial Boards for the *Journal of Physics D: Applied Physics* and *Materials*. Over the past few years, she has taken on the role of Guest Editor for Special Issues in Thin Solid Films, Polymers, and Coatings. Bogdana has been appointed member of the

International Scientific Committees for various conferences in the field of plasma physics, including the *Europhysics Conference on the Atomic and Molecular Physics of Ionized Gases (ESCAMPIG)* from 2016 to 2022 and the 12th Symposium on Vacuum-based Science and Technology in 2021. Her devotion to organizing the *International Conference on Plasma Physics and Applications* in Romania dates back to its 14th edition in 2007, becoming its co-chair for the 20th edition in 2023. Presently, Bogdana holds a leadership role as one of the chairs for the Institute's initiated conference, the *International Conference on Laser, Plasma, and Radiation – Science and Technology.*

Besides her research activity, Bogdana plays a pivotal role in STEM education for the younger generation. She actively engages in promoting scientific research to society at large by participating in science fairs and exhibitions, collaborating on art and science programs, contributing to the broader dissemination of knowledge, and encouraging the understanding of science among diverse audiences. Over the years, Dr. Mitu has guided many students on their path to obtaining license or master diploma, and currently she is co-mentoring several PhD students.

In recent years, she embraced a new challenge as part of a major project at INFLPR dedicated to establishing and equipping to industrial level the *Innovation Centre in Photonics and Plasma for Advanced Materials and Technologies – FOTOPLASMAT*. This cutting-edge infrastructure aims to bridge the gap between fundamental research and the specific needs of private companies. Undoubtedly, these recent accomplishments are poised to catalyze new ideas, foster collaborations, and fortify Bogdana's standing within the plasma community in the years ahead.

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General Interest Announcements

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

Meetings and Online Seminars

- **XXVI Europhysics Conference on Atomic and Molecular Physics of Ionized Gases (ESCAMPIG 2024), Brno, Czech Republic, July 2024**

We cordially invite you to the XXVI Europhysics Conference on Atomic and Molecular Physics of Ionized Gases (ESCAMPIG 2024) to be held in Brno, Czech Republic, from 9th to 13th July 2024.

Please find the first announcement flyer at:

https://escampig2024.physics.muni.cz/assets/pdf/Escampig_1st_Announcement.pdf

For updated information, please see the ESCAMPIG 2024 website: https://escampig2024.physics.muni.cz/

Contacts:
Dr. Zdeněk Bonaventura, Chair of the Local Organizing Committee
Dr. Tomáš Hoder, Co-Chair of the Local Organizing Committee
escampig2024@physics.muni.cz

- **Symposium “Plasma and Vapor Deposition Processes” at the International Conference on Metallurgical Coatings and Thin Films (ICMCTF), San Diego, CA, USA, May 19-24, 2024**

ICMCTF is the premier international conference in the field of thin film deposition, characterization, and advanced surface engineering, promoting a global exchange of ideas and information among scientists, technologists, and manufacturers. ICMCTF 2024 will have seven technical symposia covering synthesis processes, materials (four symposia), advanced characterization, modeling, and industrial applications, and five topical sessions focused on surface engineering for sustainable development.

One of the technical symposia in the 50th ICMCTF, ‘Plasma and Vapor Deposition Processes,’ covers the development and enhancement of established technologies, and novel concepts, as well as advances in diagnostics and fundamental understanding of deposition processes. Topical sessions:

- PVD Coating Technologies
- HiPIMS, Pulsed Plasmas, and Energetic Deposition
- CVD Coating Technologies
- Deposition Technologies for Carbon-based Coatings
- Plasma Surface Interactions and Diagnostics
- Microfabrication Techniques with Lasers and Plasmas
- Modeling and Data-Driven Methods for Process Design, Analysis and Control

‘Microfabrication Techniques with Lasers and Plasmas’ is a new session within this symposium, in which strategies to synthesize nanostructured interfaces enabling few-atom catalysts, organic tissues, and optoelectronic devices, such as laser micro-texturing and plasma-assisted lithography, will be discussed.

The submission system is open for Late News Abstracts until **February 22, 2024.**

You can find more information about the symposium here: https://icmctf2024.avs.org/symposium-pp/

Contact:
Dr. Carles Corbella
George Washington University, USA
ccorberoc@gwu.edu

- **12th International Workshop on Microplasmas, 3-7 June 2024, Orléans (France)**

The call for abstracts for the International Workshop on Microplasmas **IWM-12** is now open. Please submit your abstract before **Sunday, February 25, 2024.** To submit your abstract, please go to the website: https://iwm12.sciencesconf.org/. Create your account if you don’t already have a login. Then, prepare your submission on the following link: https://iwm12.sciencesconf.org/user/submissions.

You will need to choose one of the topics covered by the Workshop:
- Microplasma generation/sources
- Diagnostics of microplasmas
- Microplasma modelling

- Plasmas in liquids and bubbles
- Applications (material processing, plasma medicine, plasma agriculture, environmental applications, industrial contributions, etc.)

We look forward to seeing you next spring in Orléans.

Contact:
Dr. Rémi Dussart
GREMI, University of Orléans, CNRS, France
iwm12@sciencesconf.org

- **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**

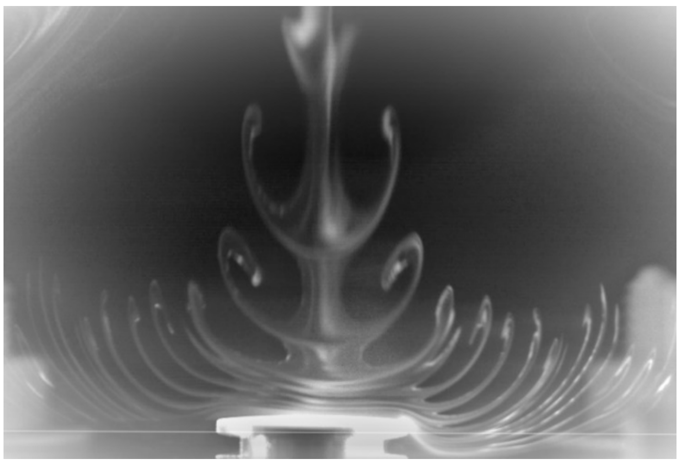
  The *International Online Plasma Seminar (IOPS)* is continuing to provide the international community with regular opportunities to hear from leading researchers in the field. The program of the IOPS (and links to past seminars) can be found at: http://www.apsgec.org/main/iops.php.

  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.

Physics and Applications of Dusty Plasmas: The Perspectives 2023



Example of dust ejected by an atmospheric pressure Ar/HMDSO flow-through plasma and interacting with a witness sample for contamination control research (courtesy of T. J. A. Staps, T. J. M. Donders and J. Beckers, CIMlabs, Eindhoven University of Technology, The Netherlands).

Dusty plasmas are electrically quasi-neutral media that, along with electrons, ions, neutral gas, radiation, and electric and/or magnetic fields, also contain solid or liquid particles with sizes ranging from a few nanometers to a few micrometers. These media can be found in many natural environments as well as in various laboratory setups and industrial applications. As a separate branch of plasma physics, the field of dusty plasma physics was born in the beginning of 1990s at the intersection of the interests of the communities investigating astrophysical and technological plasmas. An additional boost to the development of the field was given by the discovery of plasma crystals leading to a series of microgravity experiments of which the purpose was to investigate generic phenomena in condensed matter physics using strongly coupled complex (dusty) plasmas as model systems. Finally, the field has gained an increasing amount of attention due to its inevitable connection to the development of novel applications ranging from the synthesis of functional nanoparticles to nuclear fusion and from particle sensing and diagnostics to nanocontamination control.

The purpose of the present perspectives paper is to identify promising new developments and research directions for the field. As such, dusty plasmas are considered in their entire variety: from classical low-pressure noble-gas dusty discharges to atmospheric pressure plasmas with aerosols and from rarefied astrophysical plasmas to dense plasmas in nuclear fusion devices. Both fundamental and application aspects are covered.

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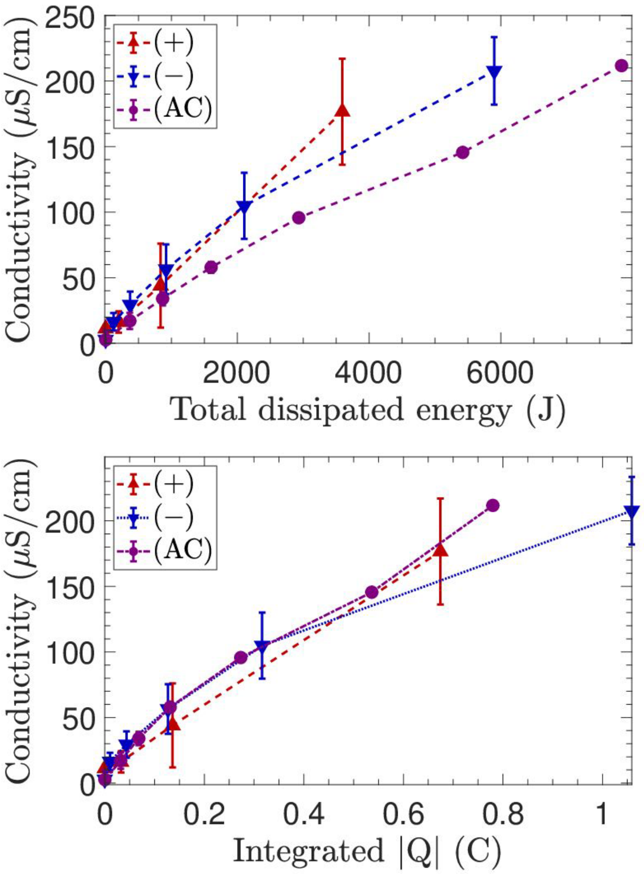
Source:
Phys. Plasmas **30**, 120601 (2023).
https://doi.org/10.1063/5.0168088

DBD-like and Electrolytic Regimes in Pulsed and AC Driven Discharges in Contact with Water



The conductivity of the water that is in contact with the plasma is a good indicator of the amount of NO_x^- ions in the liquid phase. A strong correlation was found between the water conductivity and the total dissipated energy in the plasma above the water surface, irrespective of the driving voltage (pulsed +, - or AC). The same is true for the total charge dissipated in the discharge. This shows that the total dissipated energy can potentially be used as a global measure to compare different experiments involving plasma-water interaction across different setups.

This study is about the interaction of an ambient air plasma with a water surface in a pin-water electrode configuration, performed using AC or pulsed voltage. In pulsed discharge operation, a clear distinction is observed between a dielectric barrier discharge regime featuring a transient discharge at the rising as well as at the falling slope of the high-voltage pulse, while a steady discharge is present in the gap during the complete high-voltage pulse for the electrolysis regime. The occurrence of those two regimes is coupled to the increasing conductivity of the treated water over time, which additionally results in a quick rise of the dissipated discharge power and an increase of the gas temperature. The AC driven discharges exhibit only the electrolysis regime and do not significantly evolve over the treatment time.

The resulting water conductivity was found to be a function of the total dissipated energy, irrespective of the discharge driving mode. Additionally, the resulting water conductivity shows a strong correlation with the total transferred charge in the gas phase. The total dissipated energy can potentially be used as a global measure to compare different experiments involving plasma-water interaction across different setups in different research groups.

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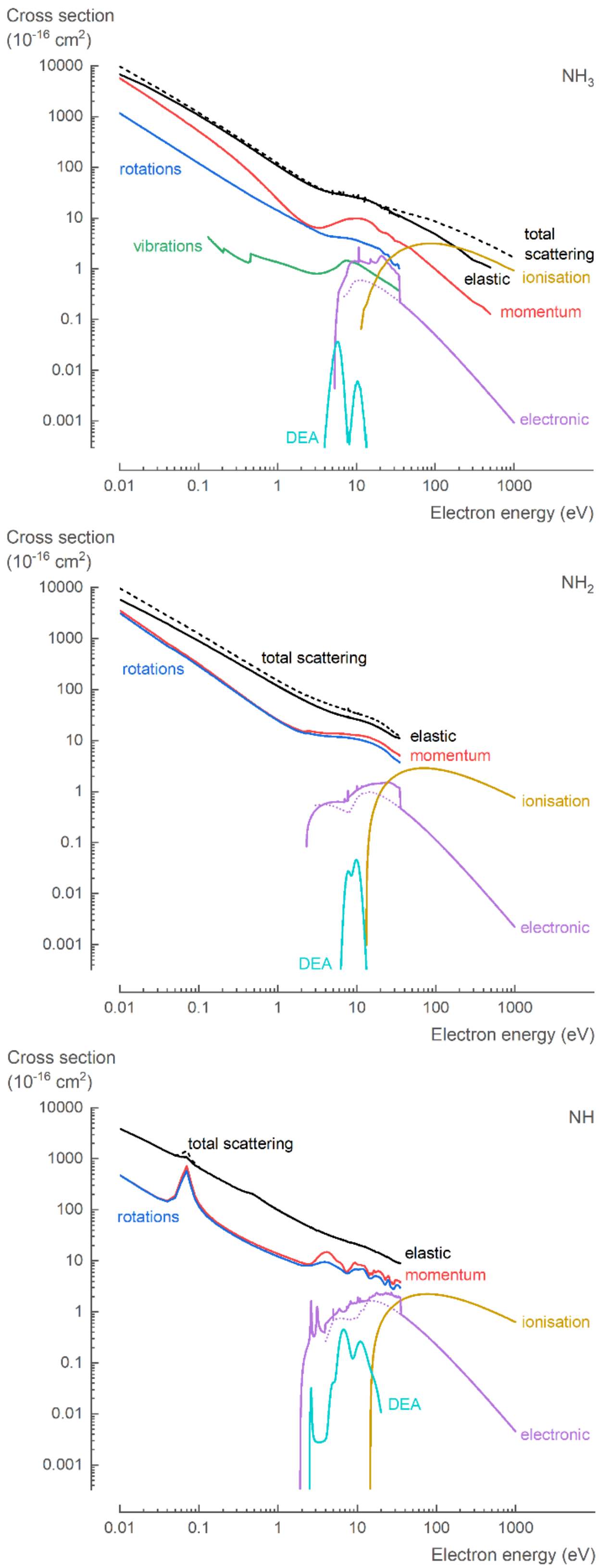
Source:
J. Phys. D, 2024.
https://iopscience.iop.org/article/10.1088/1361-6463/ad1221,
https://doi.org/10.1088/1361-6463/ad1221

Recommended Cross Sections for the Electron Collisions with NH_3, NH_2, and NH



Recommended cross sections for the electron collisions with NH_3, NH_2, and NH in this work.

Plasma-assisted NH_3 synthesis and decomposition are gaining increased attention for their potential role in sustainable electron-driven nitrogen fixation and hydrogen carrier reforming. To further advance these applications, an accurate description of the electron-induced chemistry is essential. However, a complete set of low-energy cross section data was not available for the electron collisions with ammonia (NH_3) and its radicals, amidogen (NH_2) and imidogen (NH).

Therefore, we used the ab initio **R**-matrix method to determine theoretical cross sections for the low-energy electron collision processes with NH_3, NH_2, and NH. Where possible, we compared our theoretical cross section data with experimental data and/or previous recommendations. Additionally, we explored the contribution of the different processes towards dissociation. Lastly, we presented our own recommended cross section data, which is provided as supplementary data in the format used by common Boltzman solvers (e.g. BOLSIG+, LoKI).

Use of this complete set of electron collision data should contribute to a more accurate description and better insights into the plasma-chemical kinetics behind plasma-assisted ammonia reactions for (i) technological applications, such as plasma-assisted NH_3 synthesis, decomposition, oxidation, and combustion; (ii) astrophysical studies of interstellar matter, where NH_3 is an important component; and (iii) planetary studies of atmospheres that contain NH_3.

Contact:

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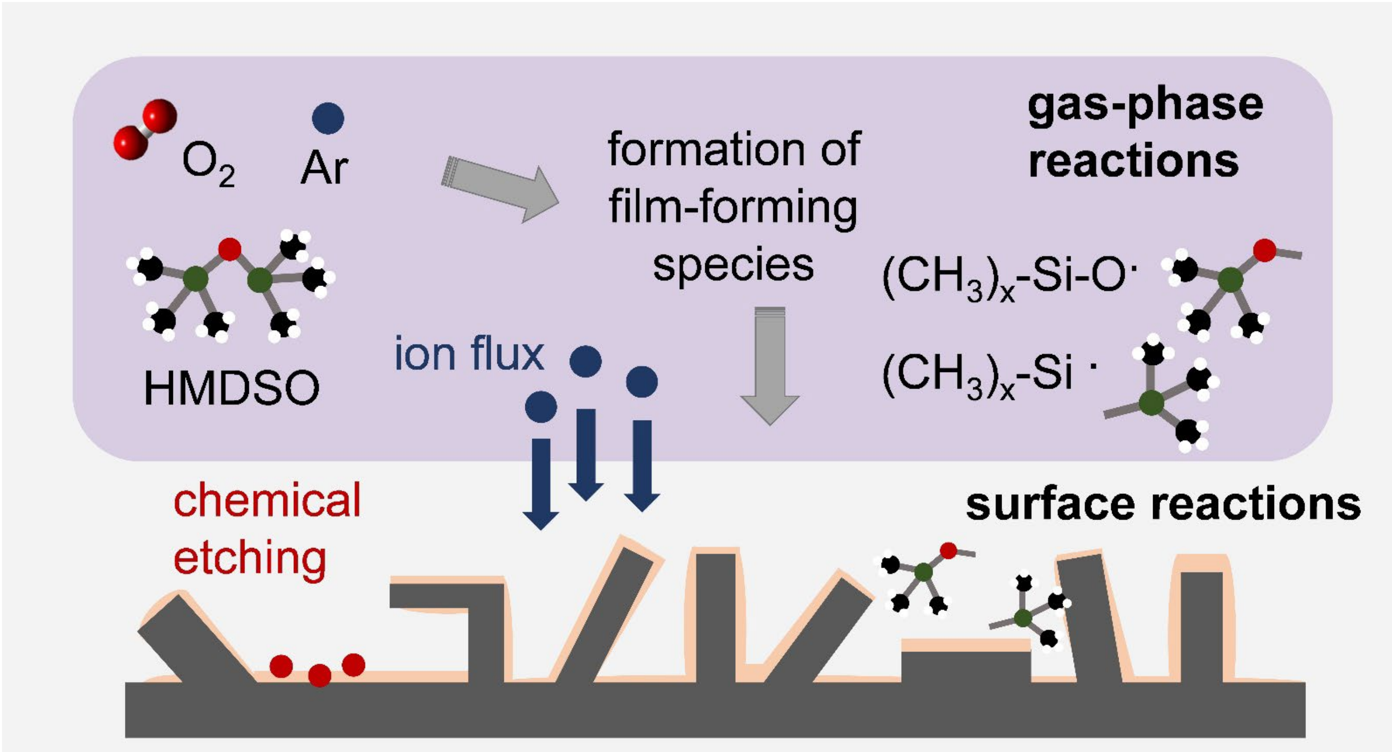
Source:

Plasma Sources Sci. Technol. **32**, 115020, 2023.
https://doi.org/10.1088/1361-6595/ad0d07

About the Polymerization Mechanisms of Hexamethyldisiloxane (HMDSO) in Low-Pressure Plasmas Involving Complex Geometries



Schematic of polymerization mechanisms in low-pressure plasmas withHMDSO as the monomer.

Low-pressure plasmas involving the polymerization of hexamethyldisiloxane (HMDSO) are renowned for their versatility in depositing plasma polymer films (PPFs) with diverse properties and applications. Despite decades of investigation, questions persist regarding the reaction mechanisms governing plasma polymer formation, particularly in the context of deposition on three-dimensional materials featuring intricate geometries such as cavities and undercuts. This study focused on two selected configurations, namely *cavity* and *undercut*, to explore the impact of diffusion of film-forming species and surface reactivity in HMDSO plasmas both with and without O_2 admixture. Analysis of the spatial chemical composition of the plasma polymer deposited along the penetration depth in these configurations revealed varying sticking probabilities of the film-forming species. Moreover, contrary to some assumptions that ion-induced effects are exclusive to direct plasma exposure, our results and additional etching experiments suggest that the influence of high-energy particles may extend beneath small openings. Lastly, the introduction of O_2 to the plasma highlights the significance of oxidizing chemical reactions at the surface within the configurations, providing clarity on their relevance.

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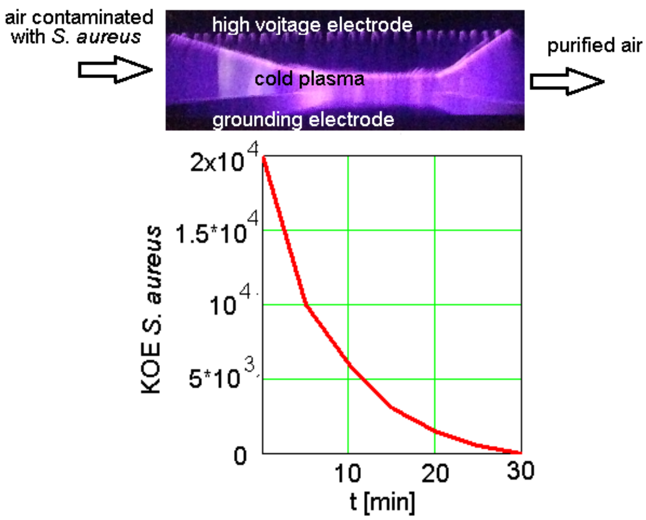
Source: Applied Surface Science **645,** 158824 (2024). https://doi.org/10.1016/j.apsusc.2023.158824

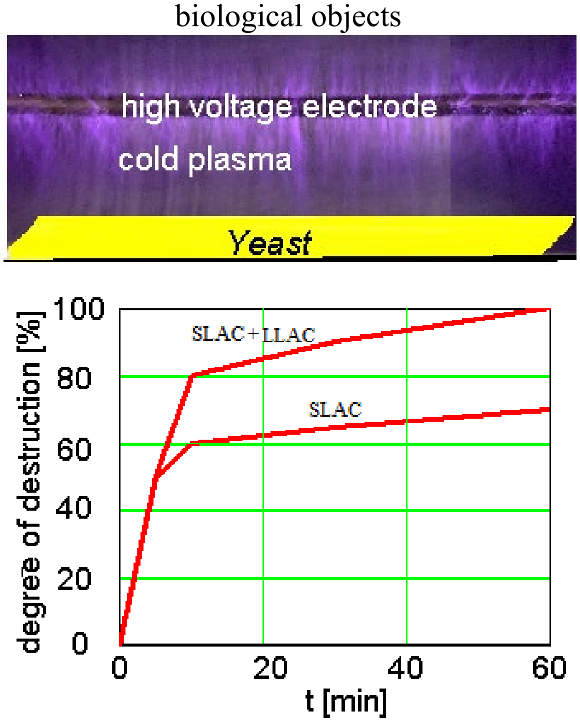
Cold Non-equilibrium Plasma as a Tool for Air Disinfection and Destruction of Biological Objects

Inactivation of bacteria S. Aureus



Dependence of the degree of purification from bacteria in a closed room on the time of CNP by power 0.6 kW speed volume 70 m^3/h.

Yeast as an indicator of the effect of destruction of biological objects



Dependence of yeast destruction on exposure time of CNP.

Cold nonequilibrium plasma (CNP) was generated by a nanosecond streamer corona in a two-electrode system by pulses with an amplitude of up to 50 kV, a duration of 100 ns and with frequency up to 600 pps. CNP is an effective means for both the destruction of bacteria in the air and the destruction of biological object on the surface. It was found that the complete inactivation of bacteria S. Aureus with a concentration of $2.1 \cdot 10^4$ KOE m^{-3} occurs at a specific energy of CNP of 28 $J \cdot l^{-1}$. The results of experiments on the destruction of yeast using CNP established the role of long and short-lived active components of CNP (LLAC and SLAC). With quantitative data on the destruction of yeast under the action of LLACs and SLACs, the effectiveness of the latter is higher by an order of magnitude. Comparison of the results of air disinfection experiments with data on yeast destruction showed that the latter can be used for rapid analysis of the effects of CNP on other biological objects.

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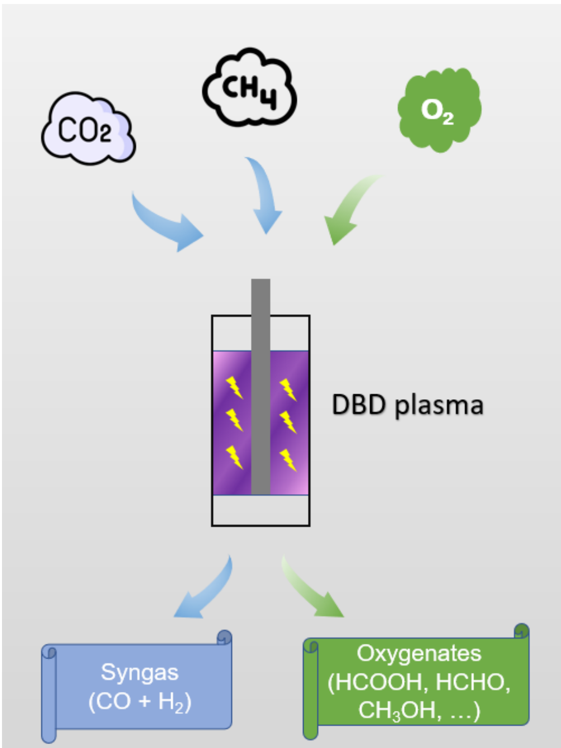
Source: A. Z. Ponizovskiy and A. V. Plochov, Current Biotechnology **12,** 169 (2023).
https://doi.org/10.2174/2211550112666230718162643

Plasma-Assisted Dry Reforming of CH_4: How Small Amounts of O_2 Can Enhance Oxygenates Production



Schematic overview of plasma-assisted DRM into high value-added oxygenates upon O_2 addition.

Plasma-based dry reforming of methane (DRM) into high value-added oxygenates is an appealing approach to enable otherwise thermodynamically unfavorable chemical reactions at ambient pressure and near room temperature. However, it suffers from coke deposition due to the deep decomposition of CH_4. In this work, we assess the DRM performance upon O_2 addition, as well as varying temperature, CO_2/CH_4 ratio, discharge power and gas residence time, for optimizing oxygenates production. By adding O_2, the main products can be shifted from syngas ($CO + H_2$) towards oxygenates. Chemical kinetics modelling shows that the improved oxygenates production is due to the increased concentration of oxygen-containing radicals, e.g., O, OH and HO_2, formed by electron impact dissociation ($e + O_2 \rightarrow e + O + O/O(^1D)$) and subsequent reactions with H atoms. Our study reveals the crucial role of oxygen-coupling in DRM aimed at oxygenates, providing practical solutions to suppress carbon deposition, and at the same time enhance the oxygenates production in plasma-assisted DRM.

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Source:
ACS Sustainable Chem. Eng. **11,** 15373 (2023).
https://doi.org/10.1021/acssuschemeng.3c04352

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, Controlled Synthesis of Gold/polymer Nanocomposite Films by Multifrequency Cold Plasma at Atmospheric Pressure, ROMES (CNRS UPR 8521), France**

  This post-doctoral fellowship will take place within the framework of the ANR PLASSEL project, the objective of which is the controlled synthesis of Au/polymer (plasmonic thin layers) and then Ni/polymer (magnetic thin layers) nanocomposite films by multi-frequency cold plasma at atmospheric pressure. This project aims to address the need for safe by design processes to produce a wide variety of polymer- metal nanoparticles nanocomposite thin layers with controlled properties on large surfaces. The proposed solution, never explored before, consists of jointly using an aerosol of metal salts solubilized in a polymerizable solvent and a cold plasma at atmospheric pressure.

  The post-doctoral researcher will explore and analyze the effect of different chemical (nature and concentration of the metal salt) and electrical (intensity and modulation of applied voltages) parameters on the properties of the deposited nanocomposite films. For this, he/she will use optical and electrical characterizations of the plasma and of the obtained films. He/she may also be involved in the simulation of the optical properties of the nanocomposite films and their link with the morphological properties. Secondly, he/she will extend the synthesis to other metals, such as nickel, by seeking to obtain metastable forms of metal nanoparticles that can lead to high added value applications in the field of magnetism. Activities include:

  - Atmospheric pressure plasma synthesis of nanocomposite films.
  - Optical and electrical characterization of plasmas.
  - Morphological, chemical and optical characterization of thin films (AFM, SEM, optical absorption, spectroscopic ellipsometry).

  The PROMES laboratory is a CNRS Unit (UPR 8521) attached to the Institute of Engineering and Systems Sciences (INSIS) under agreement with the University of Perpignan via Domitia (UPVD), France. The laboratory brings together around 150 people from the CNRS and the UPVD around a unifying subject, solar energy and its use as a source of energy and high temperatures. The researcher will be assigned to the Perpignan site, and be part of the Materials for Energy and Space group, which gathers more than thirty researchers involved in the development and understanding of the materials for the future.

  Interested applicants should send a CV and a motivation letter to the contact:

  Contact:
  Dr. Françoise Massines
  Directrice de Recherches au CNRS, PROMES-CNRS, France
  francoise.massines@univ-perp.fr

- **Post-doctoral Position, Nanocalorimetry Metrology for Plasma-based Process Monitoring, NIST, Gaithersburg, MD, USA**

  NIST (National Institute of Standards and Technology) Materials Measurement Science and Nanoscale Device Characterization Divisions are expanding their research programs toward development of Advanced Metrology for Future Microelectronics Manufacturing.

  Currently, a postdoctoral position for highly motivated and experienced experimentalist is available **to develop and test the nanocalorimetry-based in-situ metrology for plasma-based process monitoring**.

This experimentalist position requires hands-on expertise in design and assembly of model plasma reactors, plasma diagnostics with Langmuir, optical probes, and measurements of radical / ion fluxes and energy distributions at the substrate level as well as deep knowledge of plasma-surface interactions. The preferred candidate will have some experience with SEM sample characterization, semiconductor device fabrication processes, excellent writing, communication, and teamwork skills. The post doc will work closely with the project leaders and will be encouraged to reach out to other parties across NIST for cross-lab collaboration. We would like to find someone who can start early in 2024.

This position is up to three years and is located at the NIST campus in Gaithersburg, MD, USA. For further information and application process, contact **Dr. Kolmakov**.

Contact:
Dr. Andrei Kolmakov
NIST, Gaithersburg, MD, USA
andrei.kolmakov@nist.gov

- **Post-doctoral Researcher, Computational Plasmas and Plasma Surface Interactions for Materials Synthesis, University of Michigan, USA**

The Computational Plasma Science and Engineering Group at the University of Michigan, Ann Arbor, USA (https://uigelz.eecs.umich.edu/) has an opportunity for a post-doctoral researcher (PDR) in modeling low temperature plasma chemistry and plasma surface interactions. The group has several projects in atmospheric pressure plasmas for material synthesis and in low pressure plasmas for microelectronics fabrication to which the PDR will contribute. The PDR will develop and apply new computational algorithms for plasma transport (reactor scale) and plasma surface interactions (nano-scale). The position includes interaction with collaborators and sponsors of the research, and supervising/mentoring group members. The position is available in March 2024 and has a term of up to 3 years. The PDR should have completed his/her PhD in a physics or engineering discipline prior to starting the position, and should have a broad knowledge of low temperature plasma physics and chemistry with experience in computations.

Applicants should submit a cover letter describing their background and research interests and a CV (including a list of publications and at least 2 references) as a single PDF file to the contact below. Please also arrange for 2 letters of reference to be sent to the contact.

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.

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