International Low Temperature Plasma Community

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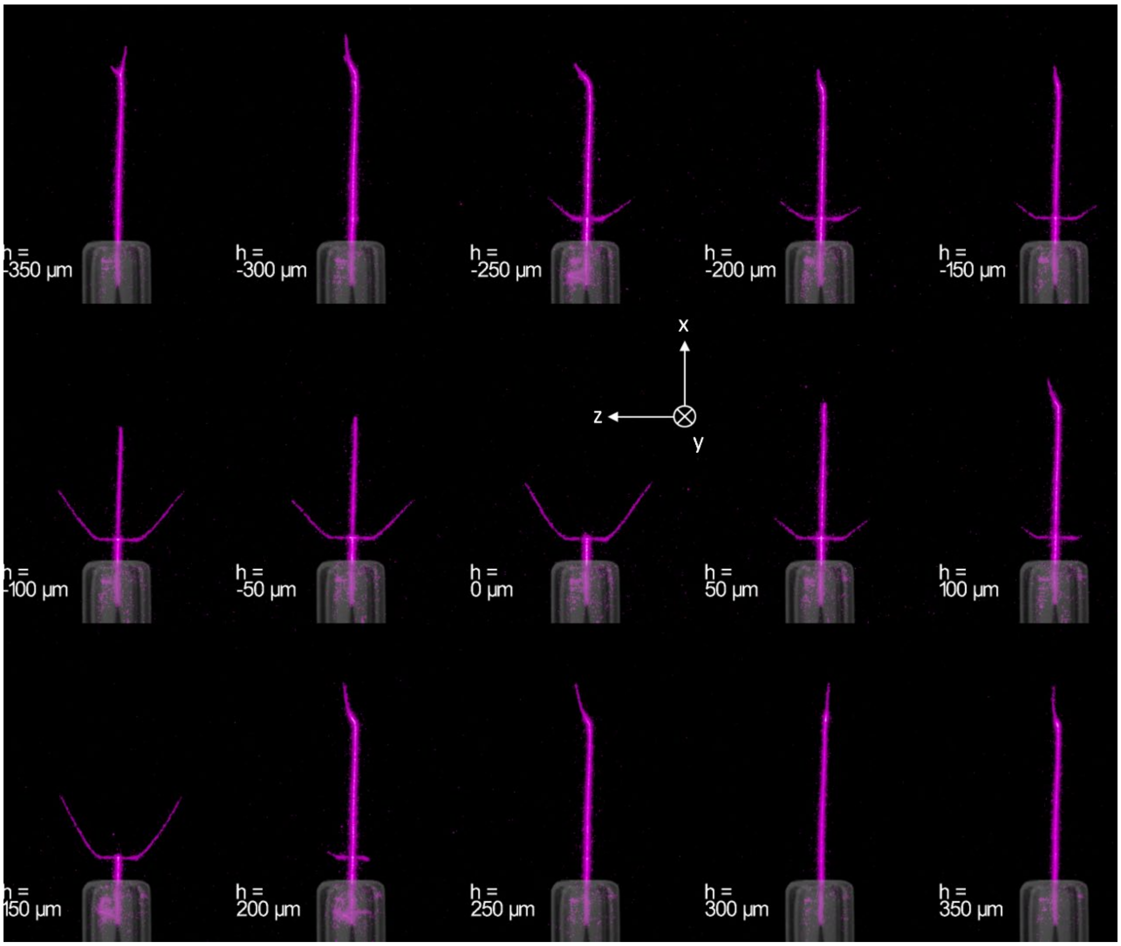
Newsletter 32

24 May 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.



Plasma-laser interaction during E-FISH experiments: Electric Field Induced Second Harmonic generation (E-FISH) experiments on plasmas are considered non-invasive. However, for a ns pulsed plasma jet in N_2 at atmospheric pressure, it is observed that the trajectory of the generated bullets is influenced by the ps pulsed laser beam. The ICCD images above show the plasma jet trajectory (in purple) for different positions h of the plasma source along the y-axis. When h=0, the laser beam is focused at the center of the plasma trajectory. The exposure time is 220 ns. The 1064 nm laser is focused by a 500 mm lens and travels along the z-direction. The plasma bullet, which normally follows the background field lines along the x-direction, branches when crossing the laser beam path. This results in a sword-like trajectory. Branches occur at the intersection of the plasma path and the laser beam path over a range of $\Delta h \approx 450$ µm. This change in trajectory does not influence the E-FISH results when using a picosecond laser. However, for ns E-FISH a direct correspondence between the E-FISH signal and the branching is observed. **Anne Limburg** (a.a.a.limburg@tue.nl) and **Dr. Sander Nijdam** (s.nijdam@tue.nl), Eindhoven University of Technology, The Netherlands.

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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 **July 3, 2023.** Please send contributions as MS-Word files if possible – and **avoid sending contributions as PDF files**.

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 The topic can be anything you want - a recently published work, a new unpublished result, a proposed new area of research, company successes, anything LTP-related.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

Illinois Plasma Institute: A Paradigm Change for University/Industry Partnerships and Workforce Development

At the University of Illinois at Urbana-Champaign (UIUC), we recently established the Illinois Plasma Institute (IPI) to create a unique ecosystem for industrial relations. At IPI, research is carried out collaboratively by university staff and industrial employees on actual commercial equipment. This venture was organically grown by UIUC faculty, with no Federal or state support, through direct investment by companies in semiconductor manufacturing to solve problems related to plasma engineering. Plasma engineering is at the heart of EUV lithography, etching, deposition – nearly every step in making an integrated circuit. In this perspective, I share my experiences with IPI and how it works in conjunction with our Master's of Engineering (ME) program. IPI has the potential to serve as a model for university and industrial partnerships. While IPI is focused on semiconductor processing and plasma engineering, the concept could be extended to other areas. Here is how IPI works.

- A company sponsors a university research project. Identifying the company and the problem-of-interest may be the most challenging part, but alumni of the university working in industry are a natural resource. Find out what they are working on and what problems they are facing, then formulate a possible solution.
- The company sends state-of-the-art equipment to the university that is relevant to that project. The faculty member's lab may already have relevant equipment – all the better. Often this can be done in a research-park type space where proprietary work can be performed.
- In addition to researchers at the university, the company sends employees to the university. They may wish to train their employees by having them work on the project which may be a new research direction for the company. The employee can also take courses and obtain a degree. At UIUC we created a ME in Plasma Engineering. Employees who are pursuing such a non-thesis degree are not full-time students. They still work for the company which can be done partly remotely. If they attend school, the company pays the tuition, and could pay the employee on a part-time basis.
- The university can also help recruit students for the company as part of the above plan. Once such a pipeline is established, it can be self-sustaining.
- The university faculty, graduate students, and staff work with the company employees on the research project, with the company's equipment, to ensure that new ideas generated at the university can be translated into a production tool or process that the company will use. Intellectual property is likely to be considered joint, and each company/university will have different types of agreements.

Why would a company participate? Companies win because they simultaneously accelerate research and development and training/education for their employees. They can also establish a stream of new and often diverse recruits. The university wins because it is a conduit for sponsored research and a mechanism for translational research which is efficient because industry is involved and the problems are introduced by industry. The nation wins because a workforce is developed for targeted needs such as the semiconductor manufacturing sector.

How can the Government help?

- Promote the infrastructure to make this possible at a given university.
- Pay for the research projects which are selected by the partner companies in order to encourage partner company and faculty involvement. Companies may do this without a government incentive, as they have done at UIUC, but with government support, they should be very encouraged to participate.

At some educational institutions, there could be other barriers to this plan. For instance, the institution needs appropriate educational programs in place. While IPI is focused on plasma engineering, the same concept can be used for other fields of engineering, particularly if an ME program already exists.

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Ute Ebert – A Computational Visionary and Collaborator from Streamers to Gamma Ray Flashes

Ute Ebert studied physics in Heidelberg, Germany. She obtained her PhD in 1994 at the University of Essen-Duisburg (Germany) for rather theoretical work on polymer physics, employing renormalization techniques to describe polymer dynamics in quenched random media. From 1994 to 1998 she worked as a postdoc in Leiden, the Netherlands, where she is still living today. During this time Ute was introduced to streamer discharges as a pattern formation problem. The reader interested in these aspects is referred to a concise summary [1] of only 99 pages! Building on this theory, Ute was later able to show that negative streamers spontaneously branch due to a Laplacian instability.

In 1998, Ute moved to CWI, the Dutch national research institute for mathematics and computer science. She became a group leader there in 2002, while also obtaining a part-time professor position at Eindhoven University of Technology (TU/e), positions she still holds today. Ute continued to do research on streamers and other discharges, and built up the Multiscale Dynamics group at CWI by combining three scientific approaches: theory, numerical simulations and experiments. Key to this success was her ability to form and maintain collaborations, for example with numerical mathematicians at CWI, experimental partners at TU/e and partners from industry.

Lightning and related phenomena have been a particular interest of Ute. She has for example worked on sprite discharges, the generation of TGFs (terrestrial gamma-ray flashes), and lightning inception, and she formed a new collaboration to study lightning phenomena with the Dutch radio telescope LOFAR. She was recently elected as a fellow of the American Geophysical Union "for crucial theoretical, numerical and experimental insights on lightning and related sciences".

Ute is very passionate about supporting (former) students and postdocs with their careers. People like Alejandro Luque, Sander Nijdam, Anbang Sun, Jannis Teunissen and Christoph Köhn are currently working in the LTP community thanks to Ute. Another thing Ute is very passionate about is physics. When an unexpected phenomenon appears in an experiment or simulation, she is always excited by the search for underlying physical mechanisms. She cares deeply about the validity of physical reasoning and is not shy to let others know when arguments or approximations might be flawed.

Outside of work, Ute likes to do sports such as hiking, kayaking and cycling, and she is also a well-trained singer and swimmer. We are however most impressed with her knowledge of Dutch history, which far exceeds that of most Dutch people! We encourage you to discuss any of these topics (or just physics) with her at the 2023 ICPIG this July, which she chairs.

Dr. Jannis Teunissen, CWI – Research Institute for Mathematics and Computer Science, The Netherlands
Prof. Sander Nijdam, Eindhoven University of Technology, The Netherlands
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[1] "Front propagation into unstable states: universal algebraic convergence towards uniformly translating pulled fronts", U. Ebert and W. van Saarloos, Physica D **146**, 1 (2000). https://doi.org/10.1016/S0167-2789(00)00068-3

General Interest Announcements

- **Conference and Research Opportunities: Clean Energy Technologies, US National Science Foundation**

The US National Science Foundation has issued two DCL (Dear Colleague Letters) of interest to the low temperature plasma community focused on clean energy technologies and topics. As described in the DCL: *As energy use ...continues to grow, the use of clean, sustainable energy sources must increase to meet demand. These sources include energy from biomass, geothermal, wind, hydropower, tidal power, and solar sources. Clean energy represents new efficient technology based on novel fundamental concepts, the energy saved through increased energy efficiency, and conservation measures for existing technologies, as well as energy derived from renewable sources.*

Conference Proposals on Clean Energy Topics: Calling for conference proposals on identifying collaborative research opportunities for advancing science and technology for clean energy. The goal of these workshops is to initiate new collaborations in clean energy topics within academia or between academia and Federally Funded Research and Development Centers (FFRDCs).
NSF 23-108, **Dear Colleague Letter: Conference Proposals on Clean Energy Topics**
https://www.nsf.gov/pubs/2023/nsf23108/nsf23108.jsp?WT.mc_ev=click&WT.mc_id=&utm_medium=email&utm_source=govdelivery

Clean Energy Technology RAISE or EAGER Proposals: Invites interdisciplinary groups of Principal Investigators to develop potentially transformative, convergent, fundamental research proposals in the area of clean energy technologies. Two kinds of proposals will be considered: Research Advanced by Interdisciplinary Science and Engineering (RAISE) and Early-concept Grants for Exploratory Research (EAGER).
NSF 23-109, **Dear Colleague Letter: Clean Energy Technology RAISE or EAGER Proposals**
https://www.nsf.gov/pubs/2023/nsf23109/nsf23109.jsp

Contact:
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Meetings and Online Seminars

- **The Online Low-Temperature Plasma (OLTP) Seminar Series – 3 Year Anniversary**

  The OLTP seminar celebrates its third anniversary this May! It started on May 12, 2020, as a response to the pandemic and generalized lockdowns, under the initiative of Prof. Mounir Laroussi. It was promoted from the very beginning through the ILTPC newsletter, which was created under the same context. Online seminars have evolved since and are now part of the active life of our community!

  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**

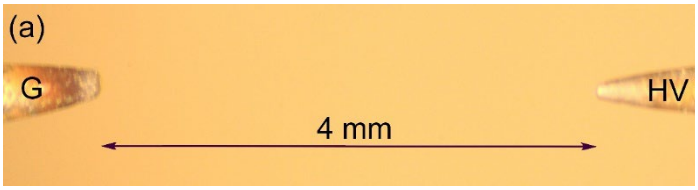
  The *International Online Plasma Seminar (IOPS)* is continuing to provide the international community with regular opportunities to hear from leading researchers in the field. The program of the IOPS (and links to past seminars) can be found at: http://www.apsgec.org/main/iops.php.

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

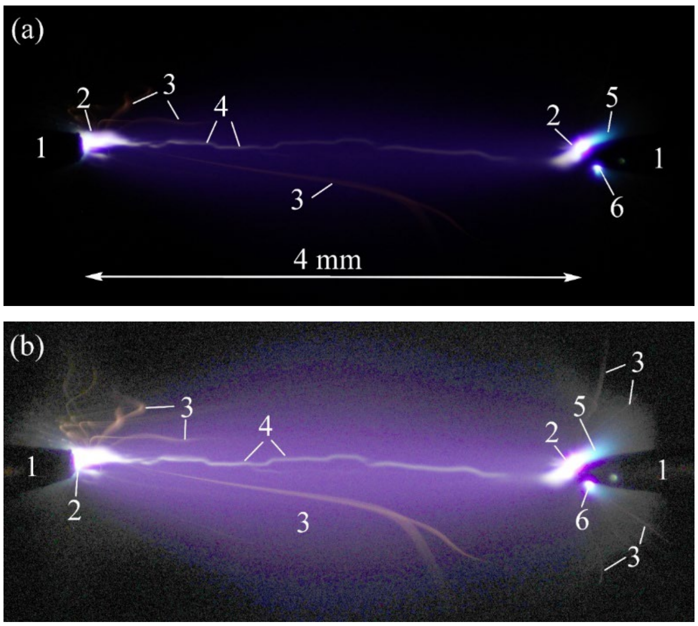
Community Initiatives and Special Issues

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

Thin Luminous Tracks of Particles in Different Gases from Electrodes with a Small Radius of Curvature in Pulsed Nanosecond Discharges



The discharge gap image. G and HV are grounded and potential electrodes.



Original image of the glow in the discharge gap (a); the same image after adjusting the brightness and contrast levels (b). 1 – bright white spots on or near the electrodes; 2 – spark leaders; 3 – areas of blue glow near the electrodes; 4 – thin luminous tracks with curves. Air pressure $p \approx 760$ Torr, the voltage pulse amplitude U_0=-33 kV and pulse duration ≈1 ns.

The breakdown of highly overvoltage gas-filled gaps continues to be intensively investigated. In the course of the research, much attention is paid to the study of nanosecond diffuse discharges in atmospheric air, formed in an inhomogeneous electric field. The formation of such discharges is accompanied by the generation of run-away electrons and x-rays. The discharges themselves find practical applications in various scientific and technical fields.

Features of nanosecond discharge development in a non-uniform electric field are studied experimentally. High spatial resolution imaging showed that thin luminous tracks of great length with a cross-section of a few microns are observed against the background of discharge glow in air and argon. It has been established that the detected tracks are adjacent to brightly luminous white spots on the electrodes or to the vicinity of these spots, and are associated with the flight of small particles.

The images are same than published in the Reprint: "Thin luminous tracks of particles from electrodes with a small radius of curvature in pulsed nanosecond discharges in air and argon", authors Victor F. Tarasenko, Dmitry V. Beloplotov, Alexei N. Panchenko, and Dmitry A. Sorokin. The article has been submitted to the journal *Nanomaterials*.

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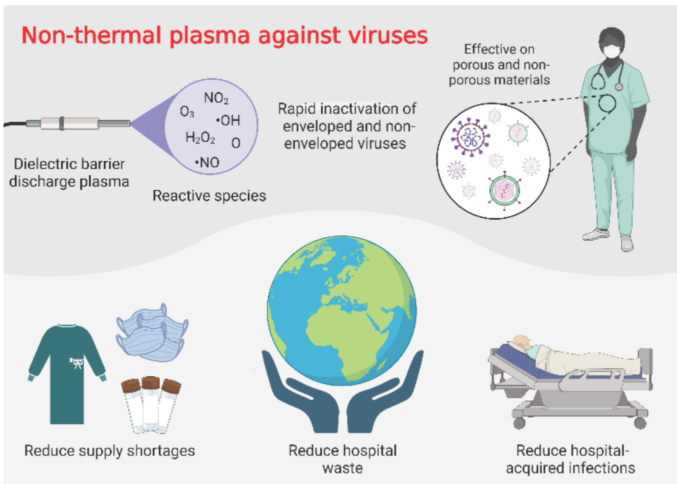
Inactivation of SARS-CoV-2 and Other Enveloped and Non-enveloped Viruses with Non-thermal Plasma for Hospital Disinfection



Non-thermal plasma for the disinfection of hospital materials as a sustainable solution to reduce costs and waste production.

As recently highlighted by the SARS-CoV-2 pandemic, viruses are an increasing burden for health, global economy, and environment. The control of transmission by contact with contaminated material is a major challenge, particularly in healthcare. However, current disinfection methods in hospital settings suffer from numerous drawbacks. As a result, several medical supplies that cannot be properly disinfected are not reused, leading to shortages and increasing waste, thus prompting the search for alternative solutions. In this work, we successfully used a dielectric barrier discharge (DBD) non-thermal plasma (NTP) to effectively inactivate SARS-CoV-2 (Wuhan and Omicron strains), PRCV, and CVB3 from non-porous and porous materials, commonly found in healthcare facilities. Compared to hospital room surfaces where over 100 SARS-CoV-2 RNA genome copies per square centimeter can be found, the DBD NTP inactivated viral loads 500,000 times higher for the Wuhan strain and 1,000 times higher for the Omicron variant. This further demonstrates the ability of NTP technology to rapidly and effectively inactivate high viral loads from various hospital materials (log 5 reduction) and complies with the requirements of the European Union standards for virus-inactivating disinfectants (reduction > log 4). In addition, our DBD satisfies all the conditions for an ideal disinfectant set by the WHO guidelines. DBD NTP is an attractive, environmentally friendly solution for disinfection of moisture- and temperature-sensitive materials without the need of additional gases or chemicals. We believe that large-scale DBD NTP devices for disinfection of hospital materials present a novel, sustainable solution to help reduce costs and waste production, for both future pandemics as well as routine daily practice.

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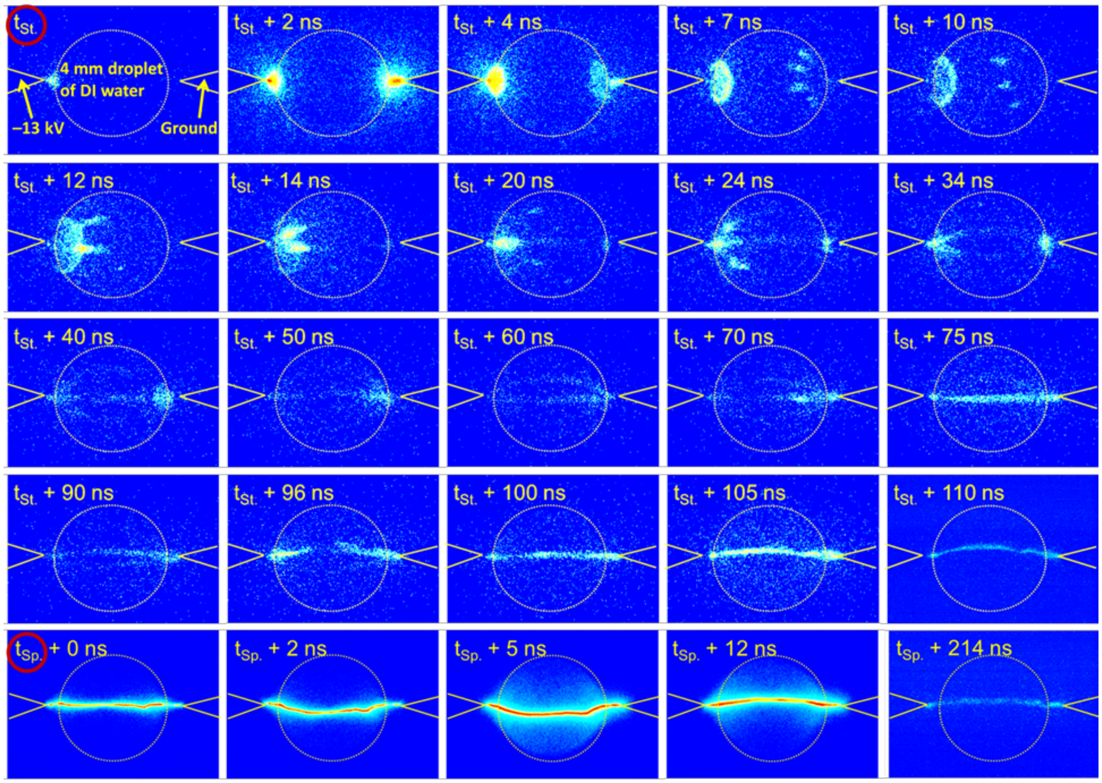
Source: ACS Sustain. Chem. Eng. **11** (13), 5206 (2023).
https://doi.org/10.1021/acssuschemeng.2c07622

Propagation of Single Nanosecond Discharges in Air with Water Droplets



The initiation and propagation of atmospheric pressure discharge in multiphase medium is an attractive research field that allows for the understanding of plasma physics fundamentals. The image at left shows the temporal evolution of a streamer emission (2 ns exposure of an EMICCD) in the presence of a 4 mm on-axis droplet centered between two electrodes (gap = 5 mm). The left electrode is connected to negative high voltage (–13 kV, 300 ns), and the right electrode is grounded. The first emission detected is shown in the top-left image, and the time indicating the first stage of streamer ignition is $t_{St.}$ (which is shorter than 2 ns). The discharge ignites near the cathode and rapidly reaches the droplet. Two ns later, emission near the grounded electrode occurs. The emission close to the cathode is diffuse-like, whereas that close to the grounded electrode is less diffuse. Images recorded at 4, 7, and 10 ns after $t_{St.}$ show ionizations fronts are directed towards each other, and that the one generated near the cathode (negative ionization front) is more homogeneous than that initiated close to the grounded electrode (positive ionization front). The propagation of individual streamers associated with the grounded electrode were observed in other configuration (positive discharge in air in contact with water; Plasma Sources Sci. Technol. **31**, 045006 (2022)) and were called “plasma dots”. At 12 and 14 ns, the positive streamers encounter the negative ones, and a stronger emission occurs. Emission in the gap at 20–40 ns is probably due to the propagation of a second ionization wave from the cathode to the anode. Between 50 and 70 ns, localized emission propagating from the grounded electrode to the cathode is observed, and at 75 ns, a single filament connecting both electrodes and propagating at the top of the droplet is identified. Beyond 75 ns, the discontinuous emission between the electrodes becomes more intense (e.g., 96 ns), then becoming continuous. Finally, the emission becomes more continuous and intense, (e.g., 105 ns). The last image (110 ns) was recorded at lower camera gain (10 vs. 10000) to avoid saturation during the spark phase (i.e., at $t_{Sp.}$). The highest intensity of the spark phase is at ~5 ns after $t_{Sp.}$. During propagation, the filament remains centered at the top of the droplet, and its emission decreases until extinction at $t_{Sp.}$ + ~240 ns. Data for different conditions of droplet size, number, or position in the gap have been recently reported in J. Phys. D **56**, 215202 (2023).

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Synthesis of Thin-film Materials Using Nonthermal Plasma at a Higher Degree of Dissociation

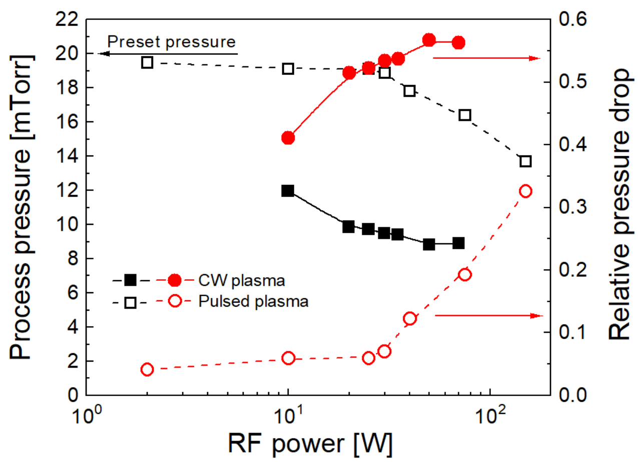

Figure 1. Power-dependent process pressure and the corresponding relative pressure drop for continuous wave and pulsed plasma; RF, radio frequency.

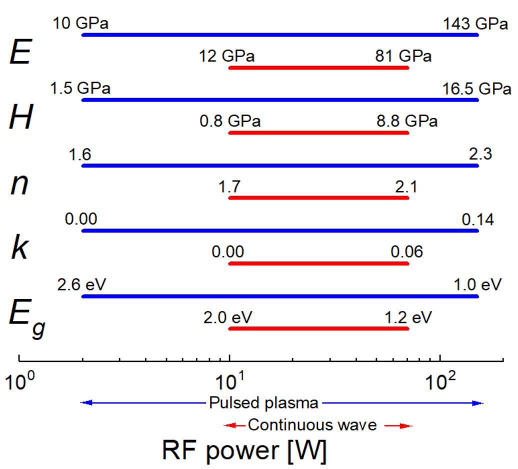

Figure 2. Physical properties of the organosilicon film can be varied to a significant extent by RF power (Young's modulus (*E*), hardness (*H*), refractive index (*n*) and extinction coefficient (*k*) at 633 nm, and band gap (E_g)).

Lower flow rates of precursor molecules are favorable for the synthesis of thin-film materials using nonthermal plasma with there being a higher degree of dissociation and a high deposition rate. These deposition conditions can be used for both continuous wave and pulsed plasmas and result in a higher consumption of precursor molecules, which is beneficial for industrial applications due to the reduction in cost. A wider range of power can be used to control the chemical and physical properties of thin-film materials based on power-dependent plasma chemistry.

Hydrogenated amorphous silicon carbide films deposited in continuous wave and pulsed plasma are used as an example. The drop in process pressure (black symbol) is characteristic of a nonthermal plasma with a higher degree of dissociation, which is related to the relative pressure drop (red symbol) driven by the discharge power, as demonstrated in Figure 1. Pulsed plasma (blue line) with a wider power range (2 – 150 W) compared to continuous wave plasma (red line, 10 – 70 W) allows changing the physical properties of organosilicon film in a wider range, especially when using higher power (Figure 2).

The different kinetics of film growth and the role of self-bias voltage in both types of plasma are discussed.

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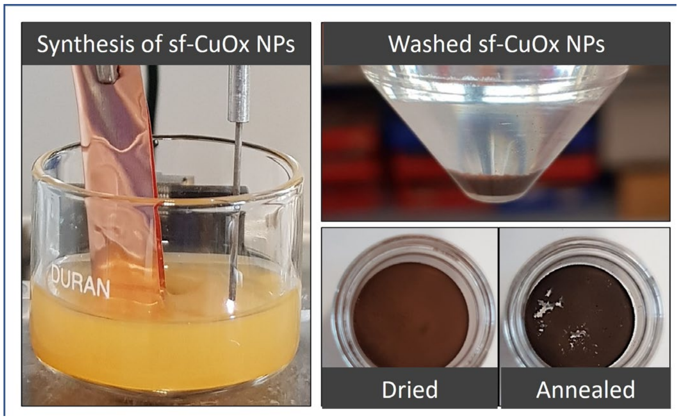
Source:
Plasma. Process. Polym. e2300019 (2023).
https://doi.org/10.1002/ppap.202300019

Efficient Solar-thermal Energy Conversion with Surfactant-free Cu-oxide Nanofluids



Nanofluids for solar-thermal energy conversion produced by plasma-induced non-equlibrium electrochemistry.

This work showcases the capability of plasma-induced non-equilibrium electrochemistry to produce nanofluids with very promising characteristics to convert solar energy into heat.

We have synthesized surfactant-free Cu-oxide nanoparticles with a plasma interfacing a liquid solution. The process uses a simple solid metal precursor, delivering highly absorbing colloids with suitable properties for solar-thermal energy conversion. The performance of the nanofluids have been assessed demonstrating the viability of these nanofluids and their exceptional performance parameters.

This also shows the viability of the plasma-based process in producing application-relevant nanofluids.

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Source:
H. S. Moghaieb, D. B. Padmanaban, P. Kumar, A. U. Haq, C. Maddi, R. McGlynn, M. Arredondo, H. Singh, P. Maguire, D. Mariotti, "Efficient solar-thermal energy conversion with surfactant-free Cu-oxide nanofluids", Nano Energy **108,** 108112 (2023). https://doi.org/10.1016/j.nanoen.2022.108112

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)

- **Professorship for Experimental Physics, Spectroscopy of Atoms and Molecules by Laser Methods, Ruhr-Universität Bochum, Germany**

  The Ruhr-Universität Bochum is one of Germany's leading research universities. The faculty of Physics invites applications for a **W2 (Tenure Track W3) professorship for experimental physics, spectroscopy of atoms and molecules by laser methods (m/f/d)** to be filled as soon as possible.

  Physics research at the Ruhr-Universität Bochum covers a broad range of topics including atomic and molecular physics in the gas phase, at interfaces and especially in plasmas. Existing research collaborations of the faculty in this area include CRC 1316 "Transient Atmospheric Plasmas - From Plasmas to Liquids to Solids" (since 2018) as well as CRC 1491 "Cosmic Interacting Matters - From Source to Signal" (since 2022).

  An excellent researcher is sought to strengthen and expand the activities of Bochum's physics in the field of atomic and molecular physics with a focus on laser methods in research and teaching. A possible research focus is the experimental investigation of the excitation of atoms and molecules in non-equilibrium systems such as plasmas. The incumbent is expected to be actively involved in the above-mentioned faculty research collaborations. Teaching is to be provided in experimental physics as part of the compulsory and elective courses of all programs offered by the faculty, as well as in teaching export. An involvement in the course "Medical Physics" is welcomed.

  A positively evaluated junior professorship, habilitation, or equivalent scientific achievements as well as proof of special suitability for academic teaching are required, as well as the willingness to participate in academic self-administration. Furthermore, the following is expected:

  - Strong commitment to teaching, enthusiasm and didactic skills in the education of students as well as the willingness to supervise bachelor and master theses.
  - Willingness to engage in interdisciplinary, collaborative scientific work.
  - Willingness to acquire third-party funded research projects.

  The Ruhr-Universität Bochum stands for diversity and equal opportunities; and expressly requests job applications from women and individuals with disabilities.

  Applications including a curriculum vitae, list of publications, list of courses taught to date, list of third-party funds raised to date, and ideas about research activities and teaching are requested by **30 June 2023** to the Dean of the faculty of Physics and Astronomy, Ruhr University Bochum, D-44780 Bochum or dekanat@physik.rub.de. More information:
  https://jobs.ruhr-uni-bochum.de/jobposting/29b02d2ea597d0a2bcaf637bd64ddd0e2a923645

  Contact:
  Prof. Dr. Achim von Keudell
  Ruhr University Bochum, Germany
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- **Post-doctoral Researcher in Thermal Plasmas for CO_2 Conversion, University of Michigan, USA**

  The Jack Lab (https://cee.engin.umich.edu/people/jack-joshua/) in the Civil and Environmental Engineering Department (CEE) at the University of Michigan, Ann Arbor, USA (https://cee.engin.umich.edu, program ranked #2 U.S. News and World Reports) invites applications for post-doctoral research fellow positions. The research will focus on the study of fundamental kinetic and thermodynamic material properties to develop novel CO_2 capture and conversion technologies. Overall, this work will focus on tailoring non-thermal plasma processes towards high reaction rates, selectivity, yields, and energy efficiencies for CO_2 conversion. This

position is currently open with an anticipated start date dependent on the applicant's availability. Appointments are anticipated for two years, with renewal after the first year, contingent on satisfactory performance and availability of funds. Successful candidates will hold the rank of post-doctoral research fellow and be provided a competitive salary, benefits, and support for conference travel/career development.
Desired qualifications: Ideal candidates should possess a recently earned Ph.D. in chemical engineering, material science, mechanical engineering, natural science (i.e., chemistry, physics) or related STEM field. A strong academic background with relevant lab experience in plasma, process design, material science, and/or physical chemistry is highly preferred.
How to apply: Please submit a cover letter addressed to **Prof. Joshua Jack** describing research experience and future research interests (1-2 pages), a curriculum vitae (including any publications), and the names and contact information of up to three references. All applications materials should be submitted as a single PDF file to the UM Careers site: https://careers.umich.edu/search-jobs. Search for job code: 233765.

Contact:
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University of Michigan, USA
jdjack@umich.edu

- **Post-doctoral Fellow, Computational Cold Plasmas for CO_2 for In Situ Resource Utilization Applications, Khalifa University, UAE**

We are seeking a highly motivated Postdoctoral Fellow to work on computational cold plasma catalysis of CO_2 and its applications to in situ resource utilization in CO_2-rich atmospheres beyond Earth's orbit. The position is with **Dr. Marko Gacesa** in the Physics Department of Khalifa University, UAE (https://www.ku.ac.ae/college-people/marko-gacesa). The successful candidate will be tasked with investigating the efficiency of cold plasma conversion of CO_2 into fuels and breathable oxygen for different plasma sources at different physical conditions and environments. We are also interested in identifying and characterizing main physical mechanisms that could boost the cold plasma conversion efficiencies beyond that of traditional thermal processes. This will be a **computational project** and **no laboratory work** will be performed. As part of the project, the researcher will have access to state-of-the-art research equipment and facilities at the Center for Catalysis and Separation (https://www.ku.ac.ae/cecas) and will get an opportunity to work alongside researchers and graduate students from various backgrounds as part of a wider team. This position can be extended contingent on performance and funding availability. Position requirements include:

- Background in computational/theoretical plasma physics modeling.
- Motivation to work on the project topics is a key requirement.
- Experience using computational codes PLASIMO, BOLSIG+, LOKI, or similar is a big plus.
- Adhere to the University's information security and confidentiality policies and procedures, and report breaches or other security risks accordingly.
- Ability to relocate to Abu Dhabi on short notice and operate in multicultural environment.

Khalifa University is ranked 181st in the QS World University Rankings 2023, and the top University in the UAE, with a range of research and academic programs designed to address the entire range of strategic, scientific, and industrial challenges facing our rapidly evolving world.
Apply at (job code 2300009A):
https://aa255.taleo.net/careersection/ku+external+portal/moresearch.ftl?lang=en&portal=8116755942

Contact:
Prof. Marko Gacesa
Khalifa University of Science and Technology, UAE
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Collaborative Opportunities

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

Disclaimer

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

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US Department of Energy
Office of Science
Fusion Energy Sciences

University of Michigan Institute
for Plasma Science
and Engineering