International Low Temperature Plasma Community

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

Newsletter 21

9 March 2022

Statement on Invasion of Ukraine

The editors of the ILTPC Newsletter strongly condemn Russia's actions against Ukraine and express our solidarity with all those who are affected by the invasion of Ukraine. We are in full agreement with the statements of European Physical Society (EPS) and American Physical Society (APS):

EPS statement: The EPS condemns the continuing attacks by the Russian Federation against Ukraine: https://www.eps.org/news/597021/.

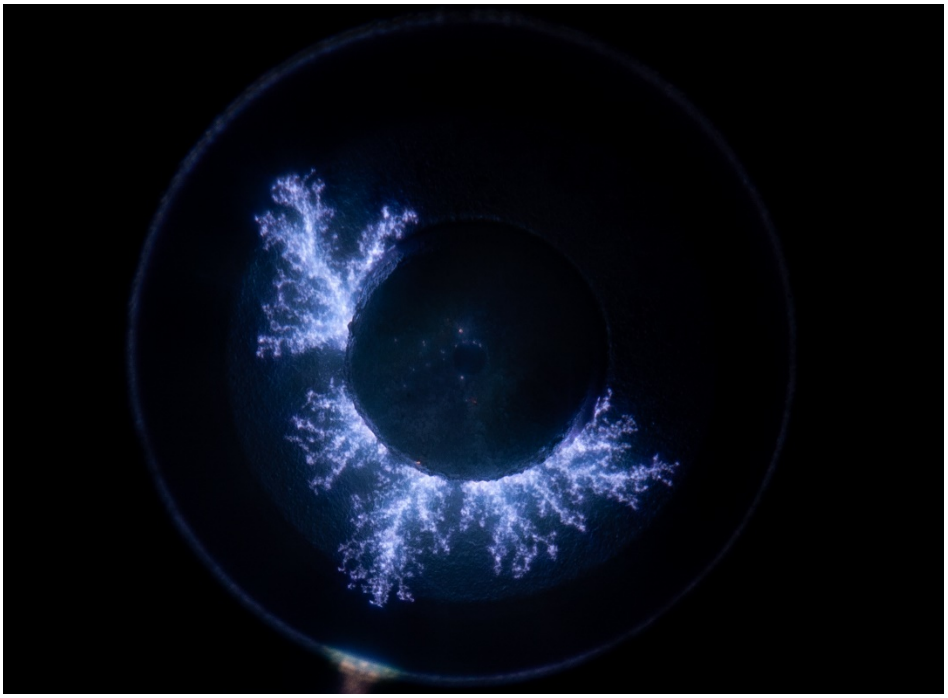
APS Condemns the Invasion of Ukraine: https://www.aps.org/about/governance/letters/ukraine.cfm.

As of this writing, the path seeking peaceful reconciliation and resolution of this crisis through constructive dialogue has seemingly been abandoned. However, dialogue and the free exchange of ideas across borders and cultures is the hallmark of science. As scientists, we have an important responsibility to continue to support academic freedom of scientists everywhere. We strongly believe that science can contribute to global unification, and we should keep working towards that goal now more than ever. As boycotts are called to sever relations with institutions, we hope that in the absence of other factors that might warrant consideration, meaningful scientific exchange with individuals can continue to work towards that unification.

Prof. Peter Bruggeman, University of Minnesota, USA, pbruggem@umn.edu
Prof. Mark J. Kushner, University of Michigan, USA, mjkush@umich.edu
Editors, ILTPC Newsletter

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.



Vacuum Arc Thruster: The image shows the operation of a small solid-state plasma thruster for micro- and nano-satellites. This type of thruster, termed a Vacuum Arc Thruster (VAT), uses a solid propellant instead of a classical gaseous propellant that requires a pressurized tank. VATs therefore offer interesting characteristics in terms of sizes, simplicity and reliability. The thrust is produced through the formation of vacuum arcs. The VAT shown here is the 30 W-class Plasma Jet Pack manufactured by COMAT (https://plasmajetpack.com/) with a Titanium cathode. Short (25 μs) high current (4-5 kA) pulses at 1 Hz generate electrical arcs that ionize and accelerate highly-charged ions from the metal cathode. The plasma emission point, or cathode spot, is characterized by a fractal structure that moves over the surface of the electrode in a random way. The fractal dimension is here 1.37. The photo shows the integrated or averaged cathode spot dynamics and motion as the camera exposure time is much longer than the pulse duration. It illustrates the complexity of the involved physical phenomena. Current studies on VATs aims at improving performances and lengthening lifetime to make them suitable for a large variety of space missions.

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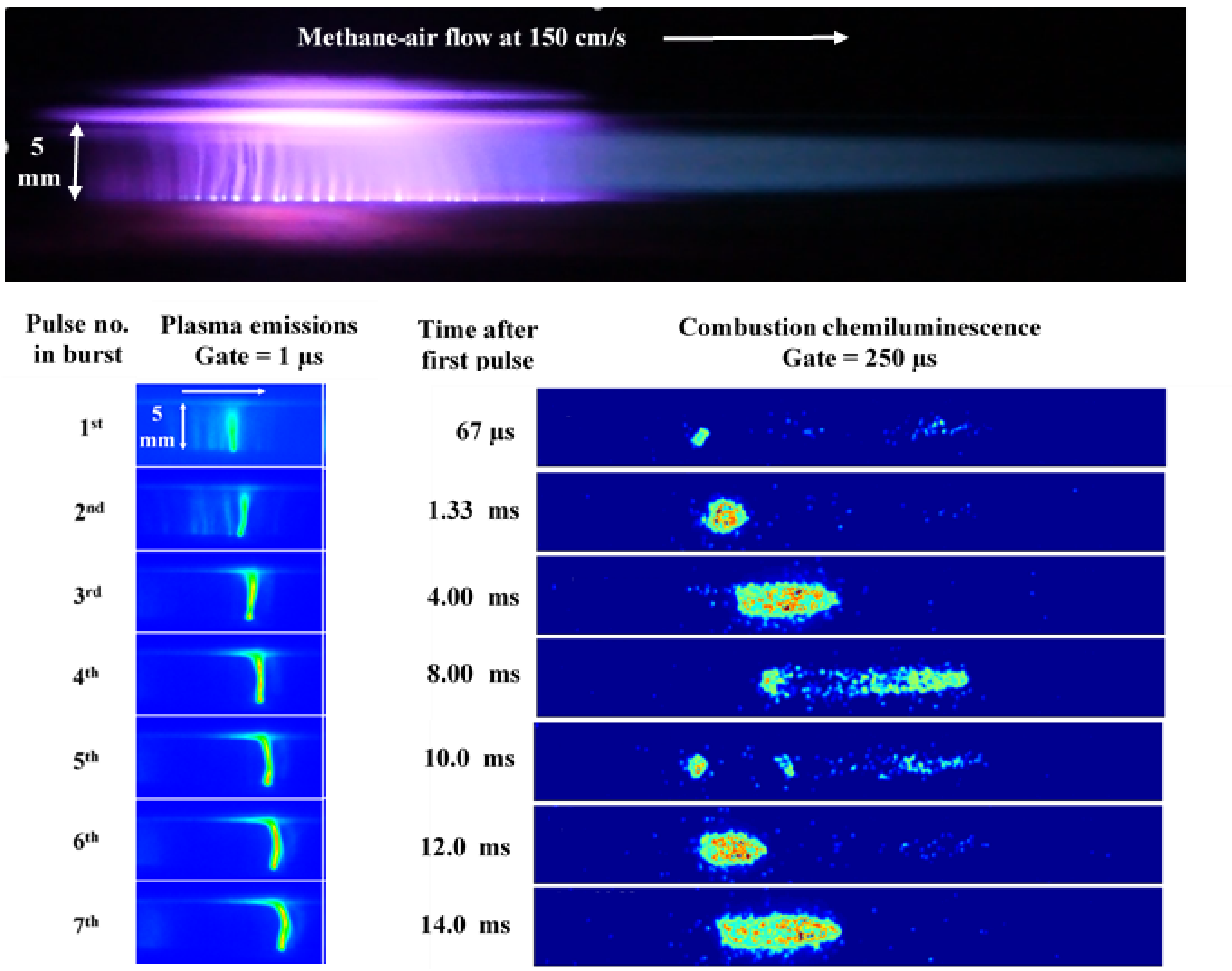

Filamentary DBD Plasma-assisted Ignition Stabilized Combustion: Non-equilibrium plasmas can help to achieve ignition in extreme conditions by generating radicals and heat at nanosecond timescales. Moreover, a continuous or fast repetitive ignition source can stabilize combustion at flow speeds much above the flame speed. An example of such an enhancement at near atmospheric pressure condition is shown in the photograph. A quartz reactor used for the study is equipped with a dielectric barrier discharge (DBD) configuration. A discharge is produced using 22 kV pulses of 10 ns duration at 2 kHz pulse repetition rate in a methane-air premixed flow at 150 cm/s flow speed, Ø = 0.7, and 700 mbar pressure. A "stable looking flame" is seen downstream from the plasma due to repetitively ignited kernels which are blowing out with the flow. To visualize these dynamics better, two sets of high-speed intensified images are shown. The plasma images made in air show that the plasma is of filamentary nature. The filament position moves with the flow due to plasma memory effects. Combustion chemiluminescence images capture the repetitive ignition dynamics at Ø = 0.7 and 100 cm/s flow speed. This includes ignition, kernel expansion and splitting, extinction, and reignition.

Contacts: **Mr. Ravi Patel** (r.b.patel@tue.nl), **Dr. Sander Nijdam** (s.nijdam@tue.nl), Eindhoven University of Technology (TU/e), 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 **April 8, 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 un-published 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

Opportunities for Expanding LTP Science into Small Colleges and Primarily Undergraduate Institutions (PUIs)

Like plasma itself, opportunities for exploration and interactions in academia can occur at many scales and environments. Plasma is studied in traditional institutions including universities, national laboratories, and industry. Recently, a new avenue for plasma research and education has developed—plasma at small colleges, liberal-arts schools, and other primarily-undergraduate institutions (PUIs).

Undergraduates work on a vacuum chamber at the Bryn Mawr Plasma Laboratory (BMPL) at Bryn Mawr College.

Research in large settings is vital for the growth and evolution of the field—places where large amounts of funding and technical expertise can accumulate. However, these sites can be disconnected to an undergraduate student population, where new workforce can be recruited. Plasma science has a low profile at the undergraduate level especially compared to other major fields such as condensed matter, AMO, and astrophysics. Many students do not learn of plasma physics or engineering until they are already in graduate school. Even at the major plasma hubs, with dozens of researchers, scientists, and technicians, few positions are held by tenured faculty who have the largest contact with undergraduates. This lack of contact impacts both the total amount of workforce entering plasma science as well as the diversity of the research population.

These workforce issues have been identified as problematic by recent community reports including the *Plasma 2020 Decadal Study*. One recommendation from that study emphasizes bringing plasma to PUIs: "*Increased emphasis on PSE undergraduate research and internships, particularly at principally undergraduate institutions (PUIs), will also improve awareness of our field…thus enabling a fuller, more diverse pipeline…*"

How exactly can plasma research at undergraduate institutions help the field? First, faculty opportunities at small colleges are more abundant and can directly increase the total number of plasma-trained faculty, which in turn can increase the profile of plasma science throughout academia. Even if such a faculty member does not do extensive research, a plasma professor can expand the visibility of the field through teaching and mentoring undergraduates. Second, the footprint of plasma research can be greatly expanded throughout the academic landscape. Most small colleges and liberal-arts institutions (and many research intensive universities) do not have a single plasma scientist in their department. Even the presence of a single professor can impact a large number of students. Third, research demands at small schools can be conducive to smaller-scale, focused experiments. The pressures to publish and produce grants are not as stringent, allowing for more exploration or focus on fundamental aspects. Finally, research and teaching programs at small colleges can symbiotically help larger projects and facilities by increasing the pool of outside users. Expansion of plasma in small colleges coincides well with the recent emphasis of user-facility-based research.

Despite these opportunities, there are unique challenges and obstacles that come with work at a small college or PUI. These schools typically require significantly more teaching than research intensive universities. However, many smaller schools are recognizing the educational benefits of a robust research program and are seeking better balance between teaching and research commitments. Another obstacle is access to resources, including both physical equipment for experiments or computing, as well as intellectual connections with on-campus colleagues. Building a pool of resources for plasma researchers at small institutions has been one of the primary goals of the *Small College Plasma Consortium* (SCPC) (https://smallcollegeplasma.org) founded in 2019 with help from National Science Foundation (USA) funding. The consortium provides a network hub for faculty, researchers, and students at small colleges to share resources, experience and advise.

Expanding plasma into the realm of small colleges and PUIs can be an impactful opportunity and should be emphasized in the coming years.

Prof. David Schaffner
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Academician Zoran Lj. Petrović – From Swarms to Plasma Medicine and Agriculture

Zoran Lj. Petrović started his academic journey at the Faculty of Electrical Engineering, University of Belgrade and then at the Australian National University (ANU), Canberra where he obtained his PhD degree under guidance of Bob Crompton. The majority of his career has been spent at the Institute of Physics Belgrade as a research professor. He is a member of the Serbian Academy of Sciences and Arts (SASA). He has won numerous awards and has been a member and chairman of the scientific committees in our community's most important conferences (ESCAMPIG, ICPIG, EU-Japan JSPP, SPIG, etc.). His bibliography consists of a book, more than 300 refereed scientific papers and numerous invited lectures. During his rich career has been a visiting professor, fellow, associate, postdoctoral fellow at the San Diego State University, University of Colorado at Boulder, KEIO University Japan, Australian National University, École Polytechnique, Paris, France, Ruhr University Bochum and many more. He retired in 2019 from the position at the Institute of Physics and after retirement he took a part time position at the Ulster University, Northern Ireland, UK where he is now Professor Emeritus. Regardless of his constant scientific activity after retirement, he never neglected his full-time position as a granddad of five fabulous and demanding grandchildren.

His scientific activities started at ANU in the field of atomic and molecular collisions and transport in ionized gases. He laid some important stepping stones in kinetic theory through swarm analysis of kinetic phenomena, solutions of Boltzmann equation and Monte-Carlo simulations of transport phenomena. He worked on fluid and hybrid and Monte Carlo models of plasmas and antimatter (positrons in gasses, liquids and living tissue). Regardless of his lifelong contribution to the world of modelling of swarms and ionized gases he always promoted and emphasized experimental work as the equally important tool of a plasma physicist. He revised Townsend's theory of breakdown together with Art Phelps and studied surface neutralization and reflection and gas breakdown.

When I met him in year 2000, he was already heavily involved in construction of plasma sources for applications in material and textile treatment. My first big task was to collaborate with biologists and use plasma in treatment of seeds, which was a fairly new thing at that time. So he told me what he repeated to all his students starting a new topic "Go, play!" and we will see where it leads us. Now we know where – to Plasma Medicine and Plasma Agriculture. I still think that this is the best advice that one can get working in science. When we return to attending conferences in person, I encourage young researchers to speak to Zoran. One can always benefit from his vast knowledge in swarms and plasmas. Even if you do not want to speak about science, you can always choose a topic like movies, rock music or literature. He has no lesser knowledge there.

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Tribute to J. William (Bill) Rich

It is with great sorrow and heavy heart that I share the news of Professor J. William (Bill) Rich's passing on 7 February 2022. Bill received the B.S. in Mechanical Engineering from Carnegie Mellon University (CMU), and the Master of Aeronautical Engineering degree from the University of Virginia. He has the M.A. and Ph.D. from Princeton University, where he was a Daniel and Florence Guggenheim Fellow. Prior to coming to The Ohio State University (OSU), he was a Principal Engineer and Head of the Physics and Chemistry Section at Cornell Aeronautical Laboratory (now, Calspan Corporation). At OSU, he held the Ralph W. Kurtz Chair, and founded the Nonequilibrium Thermodynamics Laboratory (NETL) in the Dept. of Mechanical and Aerospace Engineering. He was an Adjunct Professor of Electrical Engineering at the State University of New York at Buffalo, and held visiting faculty appointments at CMU and Ecole Centrale Paris, where he was a senior Fulbright Fellow.

Bill's scholarly interests centered on theoretical and experimental research into chemically-reacting flows, gas phase molecular energy transfer processes, nonequilibrium gas dynamics, ionized gas processes, and high-energy lasers. He is the inventor of the electrically excited supersonic flow CO laser, and of processes for separating stable isotopes in nonequilibrium reacting flows. He developed methods of sustaining atmospheric-pressure electric discharges in cold molecular gases, with inhibition of electron attachment in oxygen-containing gases. He held 8 U.S. Patents, and was the author of more than 200 journal papers and scientific reports in these fields. He was a Fellow of the American Institute of Aeronautics and Astronautics, and the recipient of the 2008 Plasmadynamics and Lasers Award from the AIAA.

Bill had been on OSU faculty for over 20 years before retiring in 2007. In 1987, he founded and became the Director of the NETL, which developed into a major research center in nonequilibrium plasmas, molecular lasers, and physical gas dynamics. Over the last three decades, well over 100 students, post-doctoral researchers, and visiting scholars have worked at the NETL group, most of them recruited and advised by Bill. Several of them are currently heading well-known research groups in the US, France, Germany, Italy, and Russia.

For over 30 years, Bill was my mentor, colleague, and close friend. He was a brilliant scientist who made groundbreaking advances in the development of molecular gas lasers, gas discharges, nonequilibrium reacting flows, and molecular energy transfer. For one of his discoveries in nonequilibrium thermodynamics of molecules exchanging vibrational energy, he and Charles Treanor were nominated for a Nobel Prize in Chemistry in 1992. This remarkable result, universally known as the Treanor distribution, remains a cornerstone of nonequilibrium vibrational kinetics, and can be compared with the work of Boltzmann and Gibbs.

Bill's intellectual pursuits also included English and American literature, of which he had a truly encyclopedic knowledge, as well as history, archeology, and book collecting. Over several decades, he accumulated an amazing library with many first editions of books written by the literary giants of the 18th and 19th centuries. He wrote a series of "Book Hunting Notes" for the Aldus Society of the lovers of books and graphic arts, with photographs of stunningly beautiful books from his collection. His most recent essay, on the poetry of John Keats, appeared in their Winter 2022 newsletter. Bill wrote it in the fall of 2021, when he was already very sick but undeterred. He recited Keats' poems to me when we met to chat and exchange news.

But perhaps most importantly, Bill was the most noble, kind, patient, and generous person I have ever met. This is how he will be remembered by his children, his friends, and his colleagues. One of his close colleagues said "Never have I enjoyed a personal and professional relationship more than the one with Bill. He always brimmed with enthusiasm and optimism. He always was sure that the experiments were going to work and thanks to his brilliance and insightfulness they usually did." Another colleague said "Bill was a great man: a human person and brilliant scientist. His kindness and his attention to every young scientist allowed me and my colleagues to enter the big science many years ago." A third has said "He is the end of an era."

I owe him virtually everything that I have accomplished, and he will forever have my love and gratitude.

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General Interest Announcements

- **Exploring Possibilities for Bringing Plasma Medicine to Patients: Introducing PlasTHER COST Action**

In September 2021, The COST Action *Therapeutical applications of Cold Plasma (PlasTHER)* (https://www.cost.eu/actions/CA20114/), set up its collaborative network designed to coordinate European activity in this domain. This pluri-disciplinary network integrates experts in physics, chemistry, biology, engineering, and medical doctors from 24 countries, in academia, businesses, and healthcare.

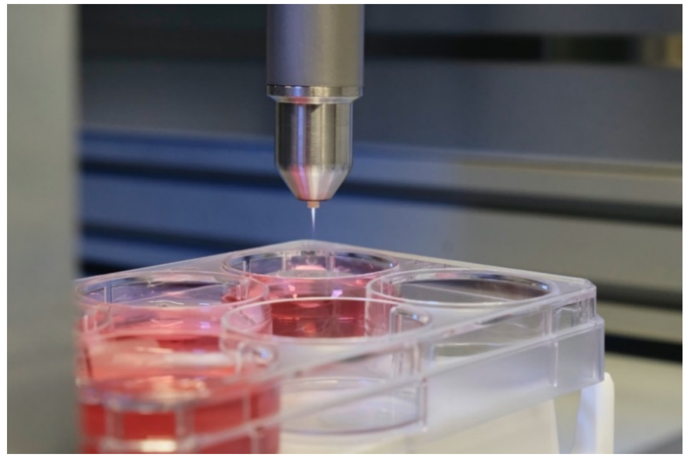
"*Thanks to the PlasTHER COST Action we will be able to push the development of the field forward in Europe, to bring the excellent research made up to date to the bench side for the benefit of the patients*" says the Action Chair, Dr. Cristina Canal.

The research will focus on the role of plasma technology and its use for standard therapeutics in biomedical applications of (e.g., antimicrobial, skin treatment and cancer therapy) pushing the field towards translation of research to practice. In this regard, the increase in research in the last 5 years in different areas of Plasma Medicine – particularly sterilisation and decontamination, wound healing, and cancer treatment – motivates the used of standardized protocols and exchanging results in a consistent manner. Doing so will enable all efforts and public investments in basic and applied science to be more rapidly translated into benefits for society and healthcare systems.

The PlasTHER COST Action aims at establishing a synergistic network that links researchers, the medical community, industry, and patient associations, among others, and coordinates European activity in this domain. To achieve this goal, four themes have been developed focusing on the basic scientific fundamentals, as well on the application and translation of therapies.

- The creation of a strongly interdisciplinary research network crossing over research field borders.
- Sharing the latest advances in the basic mechanisms regarding the action of plasmas, the most suitable CAP devices and operational conditions for efficient therapies.
- Generation of standard protocols within the community in the different therapeutic areas involved, and definition of a roadmap for each of them.
- Broad dissemination of the results to all stakeholders.

This month, the network released its new website (https://www.plasther.eu/), which keeps the community appraised of the Action's progress in exploring the potential of cold atmospheric plasmas in novel medical and biomedical applications. (image: © Toni Santiso / Rectimepro)



Planned action activities coming-up include: around 14 short term scientific missions (STSM), and the 1st Annual Meeting and PlasTHER in Summer 2022 co-located with the 9th International Conference on Plasma Medicine (https://www.cost.eu/cost-events/plasther-1am-icpm9). The first Training School organised by PlasTHER, addressing Fundamental Aspects of Plasma Medicine was the first opportunity for many PhD researchers to get together with colleagues working in the same area of research and presenting their work - “It is really enriching to discuss with colleagues doing similar research as you – one of the attendees said. This is an example of the impact of this COST Action on early career investigators.

COST supports and encourages the participation of international partners coming from non-COST Members in all of its Actions. It does so by providing financial support (to its Near Neighbour Countries) and offering Partner Member status (to its International Partner Countries).

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Prof. Cristina Canal
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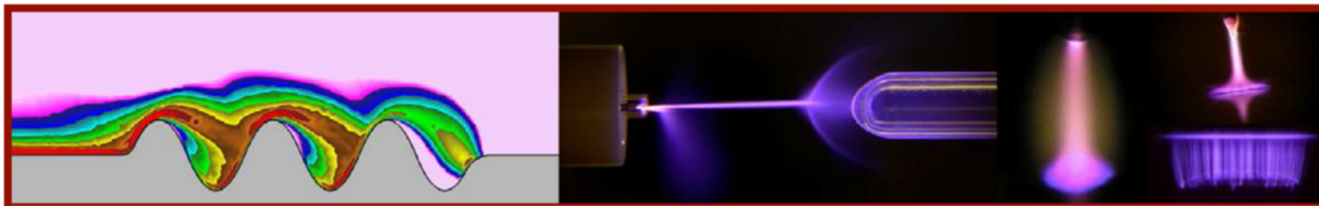
- **United States Low Temperature Plasma Summer School, June 12-17, 2022**



1st United States Low Temperature Plasma Summer School
University of Minnesota, June 12-17, 2022

Organizers: Peter J. Bruggeman (University of Minnesota), Mark J. Kushner (University of Michigan)

Advisory board:

Jane Chang (University of California, Los Angeles)
Daphne Pappas (Plasmatreat, USA Inc)
Steven Shannon (North Carolina State University)
Uwe Czarnetzki (Ruhr University, Bochum)
Edward Thomas (Auburn University)

The Summer School is inspired by the successful *Low Temperature Plasma School* in Bad Honnef, Germany. The Summer School is intended to provide an opportunity for graduate students to be immersed in the fundamentals and applications of low temperature plasmas for one week and to learn from leading researchers in their field. The US location will enable a new cohort of students to benefit from this experience. It is our hope that the School will also lead to strengthening our dynamic low temperature plasma community.

Registration process: Please send an expression of interest to Prof. Peter Bruggeman (pbruggem@umn.edu) with USLTPSS in the subject line. Please include your current position, affiliation, research topic, and one paragraph describing why you would like to participate in the summer school.
Registration deadline: May 1st, 2022 or unitl the maximum number of participants is reached
Registration fee: $200 (including accommodation)

Day	Lecture Topics	Confirmed Lecturers
Mon	Introduction to plasmas Low pressure plasmas High pressure plasmas Magnetized plasmas and plasma wave interactions	Douglas Ernie (University of Minnesota Uwe Czarnetzki (Ruhr University Bochum) Jose Lopez (Seton Hall University) Amitava Bhattacharjee (Princeton Plasma Physics Laboratory)
Tues	Plasma source design Plasma kinetics and reactions Plasma-surface interactions Dusty plasmas	Katharina Stapelmann (North Carolina State University) Uwe Kortshagen (University of Minnesota) Gottlieb Oehrlein (University of Maryland) Ed Thomas (Auburn University)
Wed	Modeling Diagnostics Hands on experience: Modeling (or) Hands on experience: Diagnostics	Mark Kushner (University of Michigan) Peter Bruggeman (University of Minnesota) Steven Shannon (North Carolina State University) Local organizers
Thu	Material processing: Low pressure Material processing: High pressure Environmental/agricultural applications Health applications Electric propulsion	Jane Chang (University of California, Los Angeles) Seth Kirk (3M) Selma Mededovic Thagard (Clarkson University) David Graves (Princeton Plasma Physics Laboratory) Mitchell Walker (Georgia Institute of Technology)
Fri (AM)	Combustion and flow control Energy applications	Igor Adamovich (Ohio State University) Elijah Thimsen (Washington University in St. Louis)
Fri (PM)	Special Topical Sessions: • Interactions of plasmas with complex interfaces • Plasma-biofilm interactions	

Organized with the support of:

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Meetings and Online Seminars

- **75th Gaseous Electronics Conference, Sendai, Japan, October 3-7, 2022**

  The 75th Annual Gaseous Electronics Conference (GEC-2022) will be a joint conference with the 11th International Conference on Reactive Plasmas (ICRP-11) on October 3 - 7 at Sendai International Center in Sendai, Japan. The scientific program occurs from Tuesday-Friday with parallel oral sessions consisting of contributed talks, invited talks, and Prize talks. Contributed posters will be presented to attendees during the afternoon poster sessions. The main program is preceded on Monday by workshops with topics on plasma-liquid/solid interaction, plasma network analysis, industrial plasmas, and plasmas for space propulsion.

  Invited Speaker Highlights

  - Instabilities and Turbulent Processes in Low-Temperature Magnetized Plasmas
    Kentaro Hara, Stanford University
  - Machine Learning Plasma-Surface Interactions: From Low to High Fidelity Surrogate Models
    Jan Trieschmann, Brandenburg University of Technology
  - Development of Validated Fluorocarbon Plasma Chemistry for Multi-Dimensional Modeling of Semiconductor Plasma Etch Processes
    Dmitry Levko, Esgee Technologies Inc.

  GEC Student Award for Excellence
  GEC Executive Committee will recognize one student presenter with the *GEC Student Award for Excellence*. Finalists will be announced on the meeting website before the meeting and will present their work at the conference.

  Contact:
  Prof. Stephan Reuter
  GEC Executive Committee
  Polytechnique Montreal, Canada
  stephan.reuter@polymtl.ca

  More information:
  http://www.apsgec.org/gec2022/index.php
  http://www.linkedin.com/groups/5170023

- **MagNetUS Meeting 1st Announcement, June 7-20, 2022, USA**

  The MagNetUS program committee is pleased to announce the second annual MagNetUS meeting to be held June 7-10, 2022. This hybrid meeting is open for anyone to attend either virtually or in person. The in-person component will be held at The College of William & Mary in Williamsburg, VA. The purpose of this meeting is (1) to spotlight exciting research in and adjacent to the MagNetUS community and (2) to foster and maintain collaborations in basic magnetized plasma research.

  Intended participants include anyone researching the basic science of magnetized plasmas. More specifically, this could include, but is not limited to, those using spacecraft data, simulationists, theoreticians, and those working with experiments ranging from collaborative research facilities (BaPSF, WiPPL, MPRL, and Frontier experiments on DIII-D) to single-PI college and university-scale labs. Members of the HED, LTP, and fusion plasma communities are encouraged to participate with an eye toward developing potentially collaborative projects for magnetized midscale facilities.

The program committee especially encourages abstracts and white papers from anyone interested in forming new collaborations or becoming a new user at one of the collaborative research facilities (BaPSF, WiPPL, MPRL, and Frontier experiments on DIII-D). In addition to sessions highlighting existing research, workshop-style sessions will be held so that prospective collaborators can present open questions and discuss how future efforts could be used to complement ongoing research.

At this time, we ask for an indication of interest using this form:

https://docs.google.com/forms/d/e/1FAIpQLSeBR0hJPIUTiqhfcgwJ3E-9l7GPCNBDNjpby3k6qV28iBp_Xg/viewform.

In the coming weeks, we will invite abstracts and white papers from the MagNetUS community and those indicating interest in the meeting. Abstracts will be for presenting completed or on-going research. White paper presentations will propose future research efforts to solicit discussion and/or collaboration.

Contact:
Prof. David Schaffner
Bryn Mawr College, USA
dschaffner@brynmawr.edu

- **Gordon Research Conference (GRC) and Gordon Research Seminar (GRS) on Plasma Processing Science, July 23-29, 2022, USA**

Applications are open to attend the Gordon Research Conference (GRC) and Gordon Research Seminar (GRS) on Plasma Processing Science.

The GRC (https://www.grc.org/plasma-processing-science-conference/2022/) will be held on July 24-29, 2022, at Proctor Academy, Andover, NH, USA. The unique format of the GRC, with invited talks and discussion sessions, poster sessions and ample time for informal gatherings, provides a fertile atmosphere for learning, creative thinking and development of new research directions. The theme of this year's conference is "Plasmas and their interactions with matter". We have put together an exciting program spanning a wide range of atmospheric- and low-pressure plasma processing science and applications.

The GRC will be preceded by the GRS on Plasma Processing Science (https://www.grc.org/plasma-processing-science-grs-conference/2022/) on July 23-24 at the same venue. The GRS is targeted explicitly at early-career researchers, who are strongly encouraged to attend the GRC as well.

Contact for GRC:
Dr. Tony Murphy
CSIRO, Australia
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Contact for GRS:
Dr. Judith Golda
Ruhr-University Bochum, Germany
judith.golda@rub.de

- **OLTP and IOPS Online Seminars**

  The *Online Low Temperature Plasma* (OLTP) seminar series and the *International Online Plasma Seminar* (IOPS) are in the process of merging the two-seminar series into a single series with the tentative name of *Online Plasma Science Seminar* (OPSS). The OPSS will be managed by the Gaseous Electronic Conference (GEC). This merger, anticipated to occur in July 2022, will enable better coordination and ultimately bigger impact.

  Until the merger becomes official, OLTP and IOPS are continuing to offer their own online seminars.

  - 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
  - The program of the IOPS (and links to past seminars) can be found at:
    http://www.apsgec.org/main/iops.php.

Dr. Anne Bourdon and **Dr. Igor Kaganovich**, OLTP Co-Chairs
Dr. Kallol Bera, IOPS Chair
anne.bourdon@lpp.polytechnique.fr, ikaganov@pppl.gov, kallol_bera@amat.com

Community Initiatives and Special Issues

- **Special Issue of PSST on "Verification, Validation and Benchmarking of Low-Temperature Plasma Models"**

Dr. Ute Ebert (Centrum Wiskunde & Informatica), Dr. Sander Nijdam (Eindhoven University of Technology), Dr. Julian Schulze (Ruhr-University Bochum), and Dr. Jannis Teunissen (Centrum Wiskunde & Informatica) acting as Guest Editors invite contributions to a special issue of *Plasma Sources Science and Technology* on *Verification, Validation and Benchmarking of Low-Temperature Plasma Models*.

Whereas modelling has frequently been used to qualitatively illustrate physical mechanisms in low-temperature plasmas, it is now increasingly possible to make quantitative predictions for real applications. This trend is driven by computational and modeling advances, as well as a better understanding of relevant processes and input data. In this special issue we will collect papers that contribute to the assessment of low-temperature plasma models and simulations through:

- Verification: A comparison of simulations and analytical solutions to test the intrinsic consistency of a model
- Validation: A comparison of simulations with experimental results or observations
- Benchmarking: A comparison of two or more models under the same conditions, but with different numerical implementations or on different scales (like particle or fluid models)

At least part of the comparison data should be original work, and the topic should fit within the scope of Plasma Sources Science and Technology. We note that there is no page charge for regular submissions, but there is a Gold Open Access option for a fee.

The full scope of the issue, as well as information on article submission is available at: https://iopscience.iop.org/journal/0963-0252/page/Special-Issue-on-Verification-Validation-and-Benchmarking-of-Low-temperature-Plasma-Models

The submission window is from now until **1 December 2022**. PSST is able to publish special issues incrementally, which means that accepted articles can be published as soon as they have gone through the production process. In this way, no delay will be incurred in the publication due to other delayed contributions. All contributions will be collected via the dedicated webpage above. Future contributions to the issue will be added as and when they have also been through the production process following acceptance. All submitted papers will be fully refereed to the journal's usual high standards. Upon publication, the issue will be widely promoted to the low-temperature physics community, ensuring that your work receives maximum visibility.

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Direct and Indirect Treatment of Organic Dye Solutions by Using Cold Atmospheric Plasma Jet

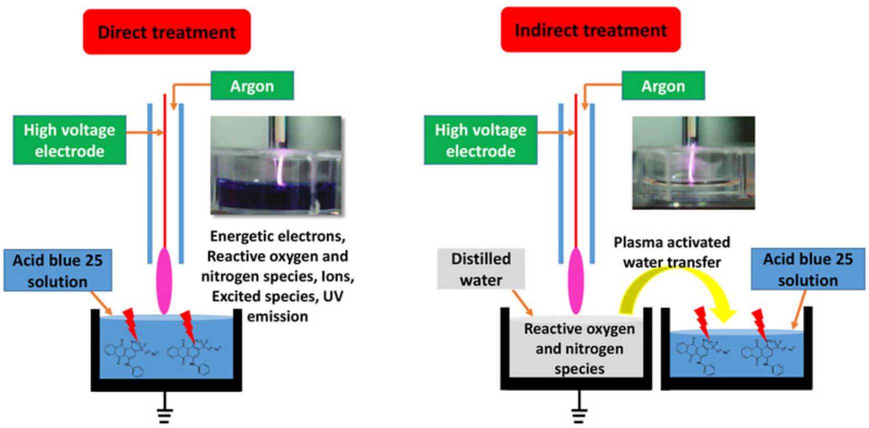

Figure 1. Schematics of the direct and the indirect treatment.

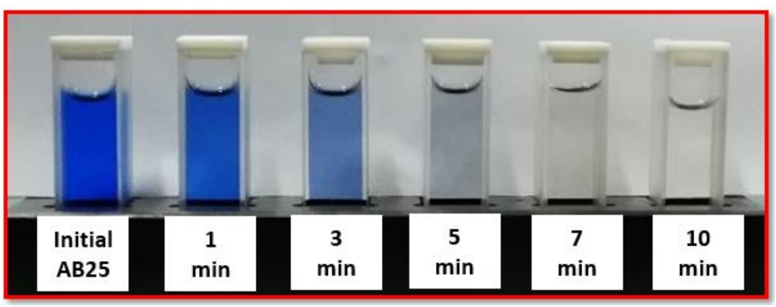

Figure 2. Color change of AB25 samples during the direct treatment by APPJ.

Generally, in the direct treatment process, where the solution is directly exposed to the plasma formed in the gaseous phase, several factors such as high energetic electrons, short and long-lived ROS and RNS, UV emission, electric field, all originating from the active plasma volume, can play a significant role in the degradation of organic dyes. However, in case of PAW application i.e. indirect treatment only long-lived ROS and RNS that remained in the water after plasma treatment can be responsible for the degradation.

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Source:
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Sustainable NOx Production from Air in Pulsed Plasma: Elucidating the Chemistry behind the Low Energy Consumption

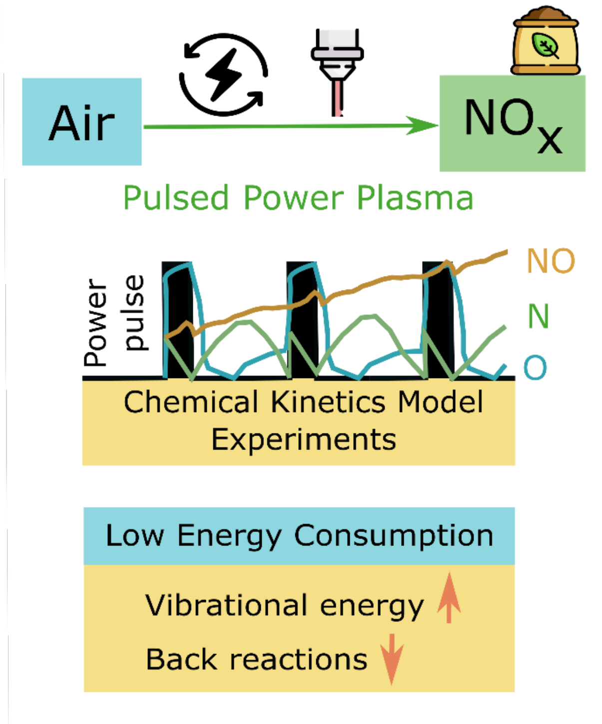

Illustration of plasma-based air conversion into NO_x via a pulsed power plasma and a graphical summary of the most important findings.

In this paper, we present a pulsed power plasma source for direct NO_x synthesis from air at atmospheric pressure. Generation of *reactive* nitrogen like NO_x plays an important role in base chemical and fertilizer production.

The pulsed power allows for a record low energy consumption (EC) of 0.42 ± 0.03 MJ/(mol.N). This is the lowest EC reported for plasma-based NO_x production at atmospheric pressure thus far.

Through plasma chemistry modelling we elucidate the underlying chemistry, and obtain very good agreement with experiments. The pulsed power and the corresponding gas temperature are the reason for the very low EC. They provide a strong vibrational-translational non-equilibrium and promote the non-thermal Zeldovich mechanism's forward- and back reactions in a delicate way. Interestingly, the temperature drop effectively reduces the back reactions, and thus NO_x decomposition. The exact pulse and interpulse times appear to be critical for finding a balance between the drop in temperature and the fraction of gas treated by the plasma (pulses). To provide a broader picture, the economic viability of the setup is discussed.

This work provides important insight into the underlying chemistry in pulsed plasmas that can be used in the development of the next generation of plasma sources for NO_x production.

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Chemical and Antimicrobial Effects of Air Non-thermal Plasma Processing of Fresh Apple Juice with Focus on Safety Aspects

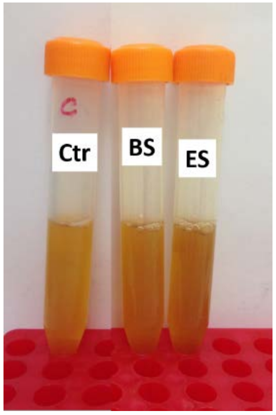

Figure 1. Typical samples of the non-treated (Ctr) and plasma treated apple juice (BS and ES) showing almost no color change.

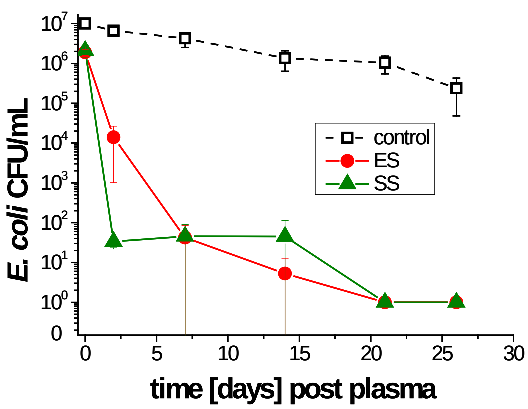

Figure 2. The post-plasma treatment evolution of the inactivation rate of E. coli bacteria with high initial load in the apple juice (mean ± SD, n=3).

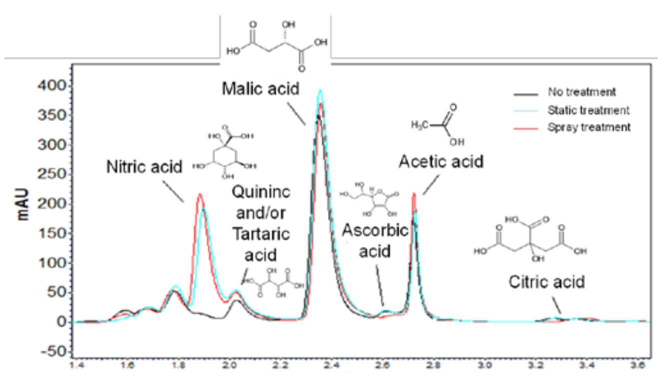

Figure 3. HPLC analyses of the untreated, static (BS) and spray (ES) plasma treated apple juice samples using instrumental conditions to detect organic acids.

Freshly squeezed apple juice was subjected to air non-thermal plasma treatment to investigate the capability to inactivate microorganisms and to evaluate its safety when applied to liquid food products. Two different configurations of a transient spark discharge in ambient air were tested: electrospray system (ES) with the juice flowing directly through the high voltage electrode, and a batch system (BS) with the discharge incident onto the juice surface. The key chemical parameters of the juice, such as pH, conductivity, color, transmittance and Brix degree did not significantly change upon treatment. The concentration of nitrates, nitrites and hydrogen peroxide formed by the plasma decreased within 24h post treatment below the safety limits.

The plasma effect on individual natural components of the juice, such as sugars, organic acids, and polyphenols treated in water solutions led to their partial or substantial decomposition. However, when these compounds were plasma treated altogether in the juice, they remained unaffected. The antimicrobial effect of the plasma processing resulted in stronger (7 log) decontamination for bacteria *E. coli* with respect to yeast *S. cerevisiae*. Plasma processing led to a substantial extension of the juice shelf-life up to 26 days if refrigerated, which represents a promising application potential in food technology.

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https://doi.org/10.3390/foods10092055

New Resources

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

Career Opportunities

- **Post-doctoral Fellow in Computational Plasma Physics, West Virginia University, USA**

  The Department of Physics and Astronomy at West Virginia University (USA) is seeking applicants for a Postdoctoral Fellow in computational plasma physics, with an emphasis on a collaboration with an in-house solar- and space-relevant laboratory plasma experiment. The ideal candidate will work with Profs. Paul Cassak, Weichao Tu, and Earl Scime to use an existing particle-in-cell code with boundary conditions representing the laboratory experiment to model magnetic reconnection in kinking flux ropes in the experiment, and to run test particle simulations with an existing code to study particle acceleration in electromagnetic fields in the experiment.

  Minimum qualifications include a PhD in Physics, Plasma Physics, Space Physics, or related discipline and previous research experience in computational plasma physics (particle-in-cell simulation experience is preferred; test particle simulation experience is desirable). A full list of qualifications and instructions for how to apply for the position are available at https://wvu.taleo.net/careersection/wvu_research/jobdetail.ftl?job=18832. The application requires a cover letter including names and contact information of three references and a CV. Competitive salary and benefits are offered. Review of applications will continue until the position is filled. The preferred start date is immediate.

  The WVU plasma/space group is described at https://physics.wvu.edu/research/plasma-and-space-physics. The department energetically supports diversity, equity, and inclusion (DEI) as described at https://physics.wvu.edu/about/diversity-equity-and-inclusivity. WVU is a comprehensive land grant university enrolling nearly 27,000 students on the main Morgantown campus. WVU's Carnegie Classification is R1 ("Doctoral Universities - Very High Research Activity"). Morgantown is centrally located and regularly makes "Best Place to Live" lists because of its good schools, excellent health care, low unemployment rate, low crime rate, and abundant recreational opportunities. The WVU Research Corporation is an AA/EOE/Minorities/Females/ Vet/Disability/E-Verify Compliant Employer. To get questions answered about the position, please email the contacts.

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  West Virginia University, USA

- **Post-doc, Atmospheric-Pressure Plasma-Polymerized Films, Research Group Biosensing Surfaces, Leibniz Institute for Plasma Science and Technology (INP), Greifswald, Germany**

The INP is conducting basic and applied research focused in the use of atmospheric-pressure plasmas for the synthesis of organic thin polymers films for sensor surfaces applied in life sciences and materials research. With the objective of enabling new functionalities of the films and understand the plasma polymerization mechanisms using different atmospheric pressure plasma sources and plasma printing technology, we are searching for a team member in Greifswald starting at the earliest possible date (latest on 1st May 2022) as Post-doc for Atmospheric-Pressure Plasma-Polymerized Films (fixed term contract for 2 years, full-time appointment 40 hours/week).

Job Description

- Develop an assay or setup for experimental investigations of applied plasma polymerized sensing surfaces on biochips, microfluidics and microelectronics, to test aging and stability under flow conditions; in order to validate them for industry-related applications.
- Characterize the chemical, structural, electrical and thermo-mechanical properties of plasma-polymerized (pp) thin films by e.g. electrochemistry, SEM, XRD, XPS, FTIR, AFM, thermal analysis.
- Investigate process parameters to enhance different functionalities of the pp films (specific functional groups, electrical or thermal conductivity) for use in biosensing, microfluidic and microelectronics.
- Publish scientific results in scientific conferences, reports and in peer reviewed journals.
- Collaborate with internal and external groups as well as with industrial partners.
- Acquire third party funds and lead scientific projects.
- Supervise undergraduates, graduate and PhD students within the project.

Qualifications

- Completion of higher education studies (Master of Science or Diploma) and PhD in polymer science & engineering, polymer chemistry, organic chemistry, biochemistry, soft matter physics or related field.
- Advanced knowledge in materials characterization (e.g. FTIR, XPS, AFM) is desired.
- Previous experience in polymer synthesis, polymer functionalization, or surface chemistry is required.
- Knowledge in plasma processing, plasma polymerization, plasma printing would be an asset.
- Knowledge in biosensors and/or microfluidic applications would be an asset.
- Highly motivated person capable of independent, efficient handling of scientific questions in an interdisciplinary environment, with analytical competencies and problem-oriented thinking.
- Fluent English, German optional.
- Experience in project management, willingness and joy for independent and team work.
- Excellent communication skills, individual initiative and extraordinary engagement are required.
- High quality publications in international journals.
- Additional R&D post-doctoral experience is a plus.

Please apply with the common documents (cover letter, CV, references) giving the keyword “0463 Post Doc Atmospheric-Pressure Plasma-Polymerized Films” - preferably via our online application form (https://www.inp-greifswald.de/en/career/) - until **13 March 2022**.

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