# International Low Temperature Plasma Community

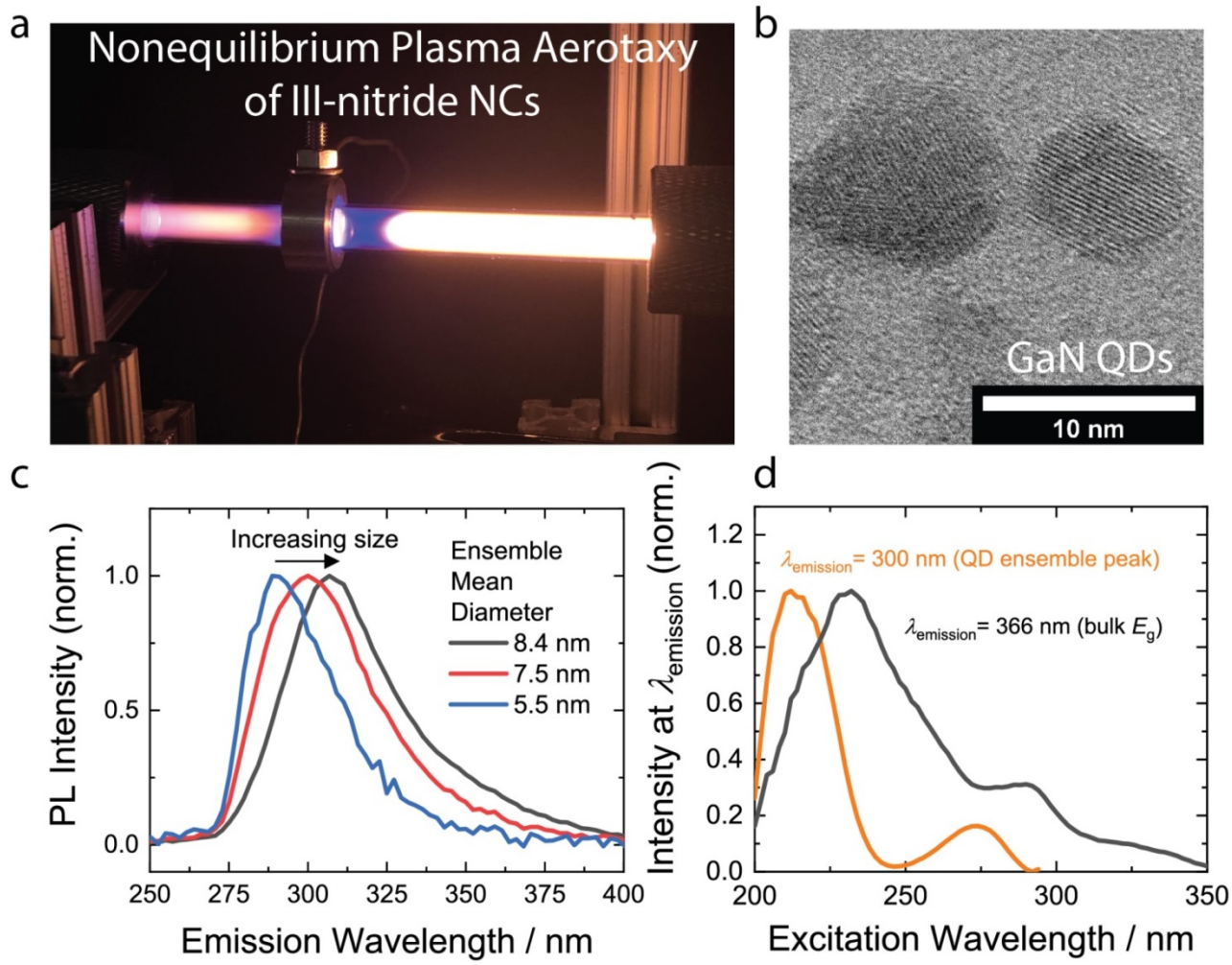
https://mipse.umich.edu/iltpc.php, iltpc-central@umich.edu

# Newsletter 16

18 August 2021

## Images to Excite and Inspire!

Please do 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.




***Synthesis of freestanding GaN quantum dots by nonequilibrium plasma aerotaxy.*** LTPs are a unique environment to produce nano-particles having unique physical, chemical and optical properties. Here we synthesized GaN quantum nano-dots. (a) Image of the plasma reactor during operation. (b) High-resolution TEM image of GaN nanocrystals in the size range of quantum confinement. (c) Photoluminescence spectra for different mean diameters under 216 nm excitation. (d) Photoluminescence excitation spectra monitoring emission from bulk GaN nanocrystals (grey, 366 nm emission) and quantum-confined GaN nanocrystals (orange, 300 nm emission). This work was supported by the Army Research Office (W911NF-18-1-0240) and was performed in part using the facilities at the Institute for Materials Science and Engineering at Washington University.
*Contact:* **Prof. Elijah Thimsen**, Washington University-St. Louis, USA, elijah.thimsen@wustl.edu.

| In this issue: | |
|---|---|
| • Images<br>• Call for Contributions<br>• LTP Perspectives<br>• Leaders of the LTP Community<br>• General Interest Announcements | • Meetings and Online Seminars<br>• Community Initiatives, Special Issues<br>• Research Highlights, Breakthroughs<br>• New Resources<br>• Career Opportunities<br>• Collaborative Opportunities |

## Call for Contributions

Please submit content for the next issue of the Newsletter. Please send your contributions to iltpc-central@umich.edu by **September 17, 2021**.

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.

**Creating Circular Food Production with Clean Alternatives for Agrochemicals**

Nitrogen fertilizers and chemical pesticides have secured our food production making famines a thing of the past in the western world. The use of these agrochemicals however come at a cost. Pesticides are found in our produce and their residues can stay in soil and water for decades. The production of nitrogen fertilizers represents 2% of global energy consumption and contributes to climate change with 3.2% of global greenhouse gas emissions. Plasma technology can offer a clean and sustainable alternative for the use of both agrochemicals. The short-term disinfecting properties of Plasma Activated Water (PAW) can be used to improve crop fitness and crop health, just by spraying PAW on the crop. The residue that remains is a low concentration of nitrate which is a perfect fertilizer that stimulates crop growth. PAW is a liquid fertilizer that can be used in drip irrigation systems.

In 2011, we started the first practical tests in agriculture with PAW with an astonishingly good result. It turned out that PAW could potentially be used as a sustainable alternative for chemical pesticides. With this application in mind, we set up large-scale tests to validate this effect on a practical scale outside the lab, again with promising results. Step by step, we further scaled up the technology, continuing to conduct a large range of testing and research in parallel with close collaboration with customers and end users. Bringing technological agricultural innovations from the lab to a practical environment turned out to be quite a challenge. The technology needs to fit within the existing infrastructure of agricultural companies and crop yields must be secured upfront. Furthermore the business model needs to fit. Without a viable business model, no technical innovation can enter the market, no matter how sustainable it is. In addition to the technology, the integration into existing infrastructure, customer value and the business model, the need for authorization and legislation are often underestimated. A thorough analysis of legislation and regulations is crucial before a new innovation can be brought to the market. Legislation often lags behind technical innovations. Sometimes the innovation simply does not fit within the existing legal frameworks.

With our company we are currently at the point where we are actually entering the market with our plasma nitrogen fixation systems. This transition represents a knowledge center for PAW, the opportunity to start working on other applications, again in close collaboration with end users and customers, and perhaps also with you.

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**Prof. Dr. Yi-Kang Pu, From Fusion to Low-Temperature Plasmas**

Yi-Kang Pu began his academic education in China as a student at the University of Science and Technology of China in the Department of Radio and Electronics, where he received his bachelor degree in 1982. He then continued his studies in the US and received his PhD from the physics department at the Massachusetts Institute of Technology (MIT) in 1989. His thesis on "Trapped Electron Modes and Anomalous Electron Thermal Energy Transport" was supervised by Prof. Bruno Coppi, one of the pioneers of fusion research. After his PhD, he worked for the Spire Cooperation as a senior plasma physicist on plasma applications until 1994. In the same year, he was appointed professor in the Department of Applied Physics at the Beijing Institute of Technology, bringing him back to China. Five years later, in 1999, he moved to Tsinghua University where he became professor in the Department of Electrical Engineering and in 2002 a professor at the Department of Engineering Physics. This is the position he holds today and where he made Tsinghua University famous in our community. It should not pass unnoted that in 2012 he was also a visiting professor at GREMI at the University of Orleans/France. Further, over the past 15 years he has collaborated intensively with the Faculty of Physics and Astronomy at Ruhr University Bochum/Germany, with countless mutual visits.

Yi-Kang has served on the editorial boards of Journal of Physics D since 2009 and as Editor in Chief of the Applied Plasma Section of Reviews of Modern Plasma Physics since 2016. He has also been on the boards of various international scientific societies and conferences, including the International Plasma Chemistry Society, the International Microplasma Workshop, the International Conference of Ionized Gases, and the Asia Pacific Conference of Plasma Science and Technology, to name only a few. A very important work was certainly the translation of the textbook "Principles of Plasma Discharges and Materials Processing" by Mike Lieberman and Allan Lichtenberg into Chinese, which greatly contributes to the distribution and use of the book within the Chinese community, in particular among students.

While in the early phase of his career Yi-Kang worked in the field of hot fusion plasmas, his focus later shifted to low-temperature plasmas, including diagnostics, modeling and plasma surface interaction. In particular, his very detailed and systematic work on collision-radiative models and emission spectroscopy in noble gases, together with his PhD student Xi-Ming Zhu, made significant progress to the field and has become a standard of today. Other significant work concerns, for example, afterglow plasmas, ionization waves, the role of surface oxidation on secondary electron yield, and discharge evolution during sputtering. In all cases, Yi-Kang has connected experimental findings with modelling in order to extract the underlying basic physics.

Yi-Kang Pu is a talented speaker and he has given invited talks at all major plasma conferences. The community knows him as a very knowledgeable, critical, and gentle person and a true leader of the field. Discussions with Yi-Kang are always inspiring and many colleagues have experienced his outstanding hospitality when visiting Beijing. Prof. Yi-Kang Pu's scientific talent and open character have made Tsinghua University one of the hotspots of plasma research. By supporting his students well beyond the scientific side of life and his exceptional engagement in the organization of conferences and workshops has contributed significantly to the personal exchange within the community, so vital for the scientific life – something we all miss so much during the present pandemic.

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## General Interest Announcements

- **Low Temperature Plasma For Biology, Hygiene and Medicine: Perspective and Roadmap**

  A team led by Mounir Laroussi has recently drafted a paper titled "Low Temperature Plasma for Biology, Hygiene, and Medicine: Perspective and Roadmap", which was submitted to the IEEE Transactions on Radiation and Plasma Medical Sciences (TRPMS). In this paper the present state of research of the various sub-fields of the biomedical applications of LTP is described, the challenges are identified, and solutions are proposed. The full list of authors is: Mounir Laroussi, Sander Bekeschus, Michael Keidar, Annemie Bogaerts, Alexander Fridman, XinPei Lu, Kostya (Ken) Ostrikov, Masaru Hori, Katharina Stapelmann, Vandana Miller, Stephan Reuter, Christophe Laux, Ali Mesbah, James Walsh, Chunqi Jiang, Selma Mededovic Thagard, Hiromasa Tanaka, DaWei Liu, Dayun Yan and Maksudbek Yusupov.

  The aims of this paper are to provide the research community with some guidance and where future research efforts could be focused. A preprint of the paper is available from TechArXiv: https://doi.org/10.36227/techrxiv.15125520.v1.

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- **National Science Foundation (USA) and Czech Science Foundation Collaborative Research Opportunities**

  The U.S. National Science Foundation (NSF) and the Czech Science Foundation (GACR) have signed a Memorandum of Understanding (MOU) on Research Cooperation. The MOU provides a framework to encourage collaboration between U.S. and Czech research communities and sets out the principles by which jointly supported activities might be developed. The MOU provides for an international collaboration arrangement whereby U.S. researchers may receive funding from NSF and Czech researchers may receive funding from GACR. Through a "lead agency model," NSF and GACR will allow proposers from both countries to collaborate to write a single proposal that will undergo a single review process at NSF.

  This NSF-GACR collaborative research opportunity focuses on discoveries and innovations in the areas of artificial intelligence, nanotechnology, and plasma science. Proposals will be accepted for collaborative research in these areas at the intersection of GACR's Call for Proposals and participating NSF programs. Specific participating NSF programs are listed on the NSF Office of International Science and Engineering (OISE) website at https://www.nsf.gov/od/oise/IntlCollaborations/CzechRepublic.jsp. Proposals are expected to adhere to the research areas, funding limits, and grant durations for these participating NSF programs and for the GACR programs from which funding is sought. As details vary by NSF program, U.S. Principal Investigators (PI) are encouraged to contact program directors of pertinent NSF programs for specific guidance.

  For more information: https://www.nsf.gov/pubs/2021/nsf21111/nsf21111.jsp.

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## Meetings and Online Seminars

- **2022 MRS Spring Meeting, Symposium "Cutting-Edge Plasma Processes Contributing to Sustainable Development Goals"**

  The 2022 MRS (Materials Research Society) Spring Meeting will be held in Honolulu, Hawai'i from May 8 to May 13, 2022 (https://www.mrs.org/meetings-events/spring-meetings-exhibits/2022-mrs-spring-meeting). In this meeting, we will hold a symposium titled "Cutting-Edge Plasma Processes Contributing to Sustainable Development Goals (SDGs)".

  The realization of a safe, secure, and sustainable society has become a global challenge, and recent plasma technology will greatly contribute to this challenge. For example, plasma technology will support the Information Age through the development of large-capacity, high-speed and highly reliable devices. Plasma-induced reactions including plasma-catalyst interaction have been applied for energy and environmental problems. Plasma-bio interaction in plasma medicine and plasma agriculture will make a significant contribution to healthy living and food security. The plasma technology is expected to contribute to the suppression of pandemics including COVID-19 in the future.

  This symposium focuses on the plasma science and technologies that contribute to SDGs, to share the cutting-edge information and accelerate their developments. There will be 15 invited talks in various fields. For more details, please visit the Call for Papers. Abstracts will be accepted **September 23–October 28, 2021**.

  Call for Papers: https://www.mrs.org/meetings-events/spring-meetings-exhibits/2022-mrs-spring-meeting/call-for-papers/detail/2022_mrs_spring_meeting/mf01/Symposium_MF01

  *Symposium Organizers:*
  **Prof. Fumiyoshi Tochikubo**, Tokyo Metropolitan University, Japan
  **Prof. Jane P. Chang**, University of California, Los Angeles, USA
  **Prof. Masaharu Shiratani**, Kyushu University, Japan
  **Prof. David Staack**, Texas A&M University, USA
  *Contact:*
  **Prof. Fumiyoshi Tochikubo,** tochi@tmu.ac.jp

- **International Online Plasma Seminar (IOPS)**

  The International Online Plasma Seminar (IOPS) is a non-profit seminar series on low temperature plasma science (LTPS). The seminars are presented bi-weekly via Zoom and attendance is free. The goal of the GEC IOPS is to make high quality research results in LTPS widely available to our community, as well as to foster an interactive scientific discussion. The current program for IOPS and information about IOPS can be found here: https://mipse.umich.edu/online_seminars.php. Nominations for future speakers can also be made from this page.

  The next IOPS presentations will be given by Dr. Daniel Lundin (**September 2, 2021**); and Dr. David Schulenberg and Dr. Dmitry Levko, (**September 16, 2021**).

  To attend IOPS, use the following Zoom link:
  https://ruhr-uni-bochum.zoom.us/j/93889931395?pwd=bFN5dU14RHRMYU5ySW40V1gvbDJpZz09

- **Online LTP Seminar (OLTP)**

  The schedule of the Online Low Temperature Plasma (OLTP) Seminar series is available at: https://mipse.umich.edu/ltp_seminars.php. The next seminars will be presented by Dr. Olivier Guaitella (**August 24, 2021**) and Prof. Amnon Fruchtman (**September 7, 2021**).

- **Special Issues on *New Aspects of Quantum Plasma Physics* and *Novel Aspects of Dusty Plasma Physics* in the Journal *Reviews of Modern Plasma Physics***

We cordially invite your contribution to the following two special issues of *Reviews of Modern Plasma Physics*:

**New Aspects of Quantum Plasma Physics**

The special issue, with Prof. A. A. Mamun as a guest editor, will be a collection of high quality review articles by leading researchers.

The study of the physics of quantum plasmas is currently undergoing vigorous development. The constituents of astrophysical compact objects (viz. white dwarfs, neutron stars, black holes, etc.) are degenerate (quantum) plasmas, which are usually explained by different quantum models and approaches. Quantum plasmas also occur in many space environments and laboratory devices.

The aim of this special issue is to provide basic knowledge to understand the properties of different quantum plasma media and the fundamental features of the various types of linear and nonlinear waves propagating in them.

We are expecting submissions by **31 October 2021**. For more information and submission instructions: https://www.springer.com/journal/41614/updates/18863512.

**Novel Aspects of Dusty Plasma Physics**

The special issue, with Profs. A. Sen and Lin I as guest editors, will be a collection of high quality review articles by leading researchers. The aim of this special issue is to provide a basic understanding on various important dusty plasma physics.

We are expecting submissions by **28 February 2022**. For more information and submission instructions: https://www.springer.com/journal/41614/updates/19371430.

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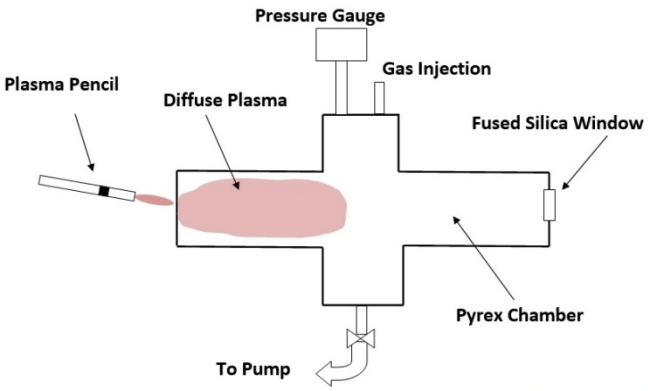
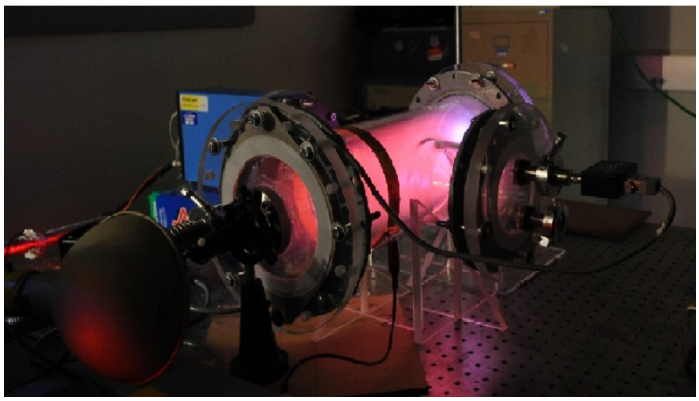
## Remote Generation of a Large Volume Diffuse Plasma



(top) A schematic of the experimental setup to ignite a discharge inside an electrodeless Pyrex chamber. The plasma jet is brought in contact with the external wall of the chamber, igniting a diffuse low pressure plasma inside the chamber. (bottom) A photograph showing the diffuse air plasma inside the Pyrex chamber where the pressure is 3 Torr. The external plasma jet (not visible) is to the right end of the chamber.

Low temperature plasma jets exhibit large electric fields, the magnitude of which was measured by several investigators to be in the 10 – 30 kV/cm range. When impinging on a dielectric material the plasma jet causes charges to build on the surface of the dielectric and via capacitive coupling, the electric field can be transmitted to the area behind the dielectric barrier. This transmitted field can ignite a new discharge if the dielectric constitutes tubing where a noble gas is flowing, or if the dielectric is the wall of a chamber/enclosure where the gas and its pressure can be controlled. Therefore, using an external plasma jet one can generate a plasma inside a containment chamber that has no electrodes and no electrical power directly applied to it. The ionization wave emitted by the plasma jet hits the external wall of the dielectric chamber and is transferred inside, and under the right conditions (gas, pressure) can ignite a diffuse volumetric plasma that fills the chamber.

The figure shows a schematic of the experimental scheme and a photograph of the diffuse plasma generated in a Pyrex chamber filled with air at 3 Torr. The advantages of this generation method are that the plasma inside the chamber is free of metal contamination (since there are no electrodes) and unlike most low-pressure RF plasma sources (capacitively or inductively coupled), there is no critical requirement for impedance matching since the driving circuitry of the plasma jet is electrically separate/remote from the chamber, which itself has no internal or external hardwired electrical connections.

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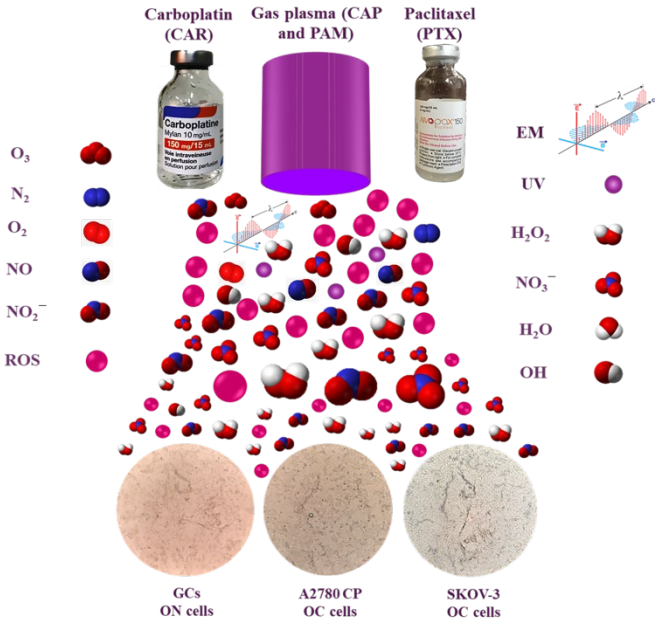
*Source:*
Plasma **2**, 380, (2019).
https://doi.org/10.3390/plasma2040030

## Co-treatment of Plasma Activated Medium and Oncotherapeutics Agents to Combat Chemotherapy-resistance in Ovarian Cancer Cells




Schematic representation of therapeutic modalities with the main effectors which were used for ovarian normal and cancer cells.

Recently, medical gas plasma technology has emerged as an oncotherapeutic modality through physical and chemical effects. Here, gas plasma directly, indirectly, and through the concomitant modality of plasma activated medium (PAM) with conventional drugs were utilized on A2780 CP and SKOV-3 cells. These studies are relevant to ovarian cancer and granulosa cell (GC) as normal ovarian cells to overcome chemotherapy resistance in ovarian cancer cells. We showed that PAM in comparison to cold atmospheric plasma (CAP) has a high potential and stronger selectivity for the selected cell lines, where the concentration of $H_2O_2$, $NO_2^-$, and $NO_3^-$ reactive species and the pH of plasma treated medium plays the main role. Furthermore, the PAM-based treatment is very promising for ovarian cancer treatment compared to the combination of common carboplatin (CAR) and paclitaxel (PTX) chemotherapy treatments. Regarding the molecular mechanisms, PAM alone and concomitantly with carboplatin sensitizes cancer cells to carboplatin and selectively induces mitochondrial-related intrinsic apoptosis. In essence, PAM treatment is an innovative and emerging technology for the future combination or multimodal ovarian cancer oncotherapy.

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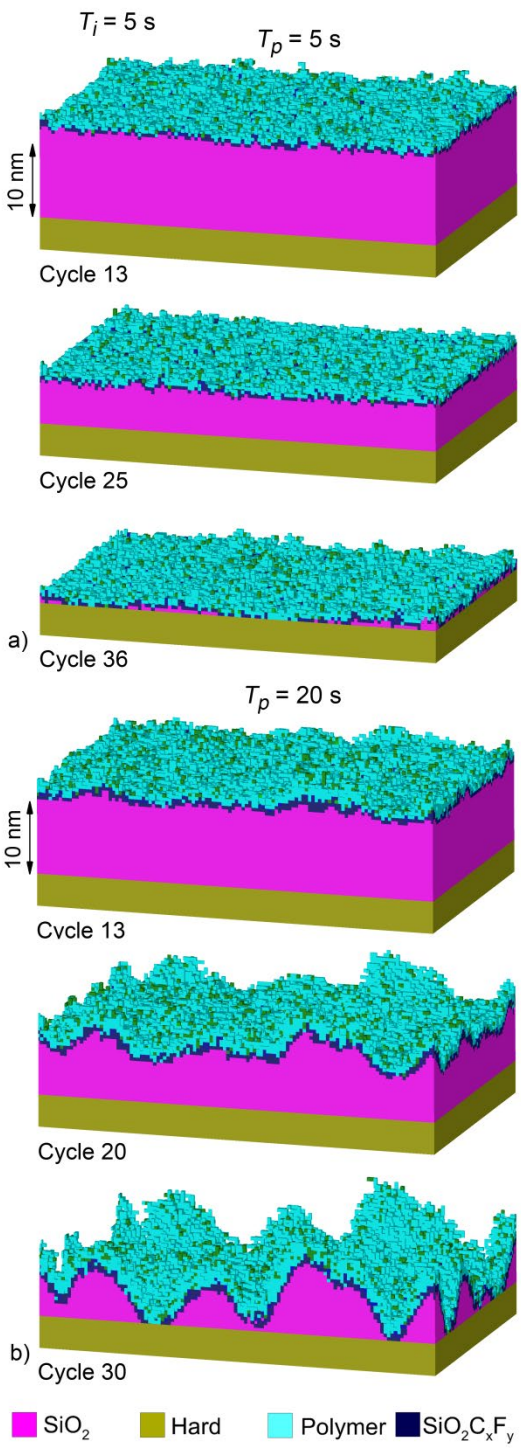
*Source:*
Plasma Processes Polym. **2021**, e2100074.
https://doi.org/10.1002/ppap.202100074

## Roughening Surfaces During Plasma Atomic Layer Etching of $SiO_2$




(top) Quasi-steady state ALE of 10 nm thick $SiO_2$ over 36 cycles producing a smooth surface. The light-blue material is polymer. (bottom) ALE having a longer passivation period over 30 cycles, leading to a progressively rougher surface.

Plasma atomic layer etching (ALE) is a two-step cyclic process designed to remove 1 atomic layer of material per cycle. Nearly ideal ALE is etching of Si by $Cl_2$ and Ar plasmas. In the first step using the $Cl_2$ plasma, Cl atoms passivate the top layer of Si atoms, a process that self terminates when the layer is fully passivated. In the second step, the argon plasma with controlled ion energies onto the substrate chemically sputters the passivated layer – a process that self terminates when the passivated layer is removed.

ALE of dielectrics such as $SiO_2$ uses a fluorocarbon plasma for the first step to passivate the surface with nm layer of $CF_x$ polymer forming a $SiO_2CF_x$ complex at the interface. This process does not self-terminate as an arbitrarily thick polymer can be deposited. In the second step, an Ar plasma chemically sputters the $SiO_2CF_x$ complex which is regenerated by the overlying polymer. Etching proceeds as long as there is polymer fuel. The etch rate is inversely proportional to the polymer thickness as ions need to penetrate through the polymer to deliver activation energy to the interface. A statistical variation in the thickness of the polymer can result in statistical nm-scale variation in the $SiO_2$ removal thereby producing roughness. Residual polymer from a previous chemical sputtering step enables a thicker polymer after the next passivation step, leading to less etching, more residual polymer and more roughness.

Reactor and feature scale simulations of ALE of $SiO_2$ demonstrate this potential for roughening. The ALE process consists of a 2-frequency capacitively coupled plasma (step 1) sustained in $Ar/C_4F_8/O_2$ for passivation and (step 2) an Ar plasma for chemical sputtering. The figure shows (top) a quasi-steady state ALE process having a passivation period of 5 seconds. For a longer passivation period of 20 s (bottom), chemical sputtering does not removal all of the polymer each step, resulting in eventual roughening of the surface.

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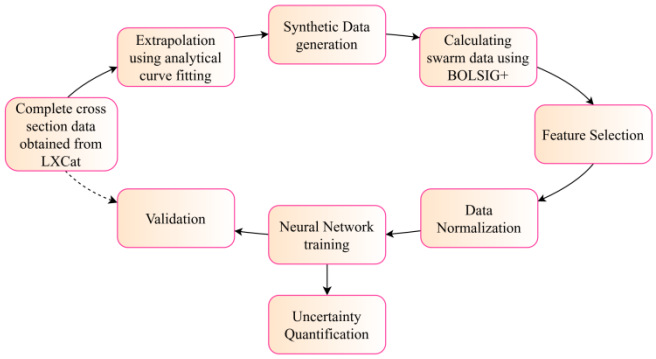
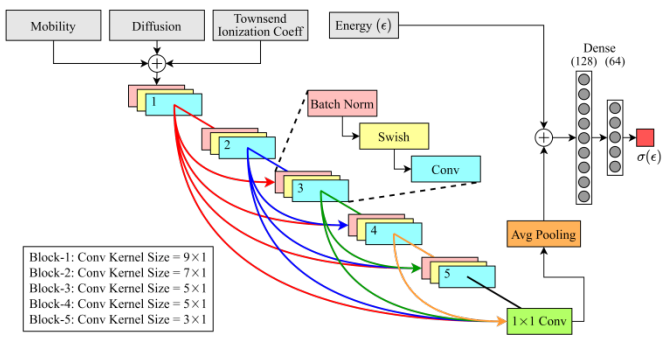
*Source:*
X. Wang et al., J. Vac. Sci. Technol. A **39**, 033003 (2021).
https://avs.scitation.org/doi/10.1116/6.0000941

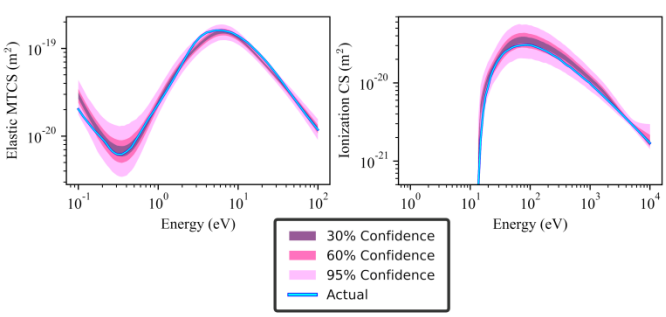
## Extracting Electron Scattering Cross Sections from Swarm Data Using Deep Neural Networks and Its Uncertainty Quantification




Workflow for solving the inverse swarm problem.




Neural network layout (DenseNet) used in this study.




Uncertainty in prediction of elastic and ionization cross section of Methane ($CH_4$).

Electron-neutral scattering cross sections are fundamental quantities in simulations of low temperature plasmas used for many technological applications today. From these microscopic cross sections, several macro-scale quantities (called 'swarm' parameters) can be calculated. However, measurements as well as theoretical calculations of cross sections are challenging. Since the 1960s, researchers have attempted to solve the inverse swarm problem of obtaining cross sections from swarm data; but the solutions are not necessarily unique. To address these issues, we examine the use of deep learning models which are trained using the previous determinations of elastic momentum transfer, ionization and excitation cross sections for different gases available on the LXCat website and their corresponding swarm parameters calculated using the BOLSIG+ solver for the numerical solution of the Boltzmann equation for electrons in weakly ionized gases.

We implement artificial neural network (ANN), convolutional neural network (CNN) and densely connected convolutional network (DenseNet) for this investigation. We test the validity of predictions by all these trained networks for a broad range of gas species and we deduce that DenseNet effectively extracts both long and short term features from the swarm data and hence, it predicts cross sections with significantly higher accuracy compared to ANN. Further, we apply Monte Carlo dropout as Bayesian approximation to estimate the probability distribution of the cross sections to determine all plausible solutions of this inverse problem.

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*Source:*
V. Jetly and B. Chaudhury, Machine Learning: Sci. & Technol. **2,** 035025 (2021).
https://iopscience.iop.org/article/10.1088/2632-2153/abf15a

## New Resources

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

## Career Opportunities

- **Faculty Positions in Plasmas, Lasers and Nuclear Fusion, Physics Department of Instituto Superior Tecnico, Portugal**

  The Physics Department of Instituto Superior Tecnico (ULisboa) is carrying out an open search process for possible candidates to future openings for tenure-track faculty positions.

  This open search is targeted at possible candidates who have interest in enrolling at the base level of the university professional career, in all scientific areas of the Department, namely: Plasmas, Lasers and Nuclear Fusion.

  More information about this process (with a deadline of September 15) can be found at the link below

  http://fplfn.tecnico.ulisboa.pt/opportunities

  *Contact*:
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- **Post-Doctoral Researcher or Scientist in the Field of Plasma-Chemical Deposition Processes, EMPA – Swiss Federal Laboratory, St. Gallen, Switzerland**

  Empa's (https://www.empa.ch/) Research Group in Plasma & Coating in St. Gallen, Switzerland (www.empa.ch/web/s402) is offering a position for a 2-3 year term. Plasma-chemical deposition processes allow for the controlled functionalization of material's surfaces at the nanoscale (see https://www.youtube.com/watch?v=He6RroQVyXo ). The research includes, but is not limited to, in-depth studies of plasma processes to achieve high control over film chemistry and nanostructure at moderate ion bombardment, building on the extensive experience and leading know-how of the group. Improved understanding based on plasma diagnostics and surface analytics will pave the way to coat soft materials as well as to deposit functional multilayers to attain novel surface properties. An important part of the work considers the interaction of plasma-modified surfaces with water as well as metal-polymer bonding, which is highly relevant in the biomedical and other fields.

  ***Desired Qualifications:*** You have a Ph.D. in chemistry, physics, materials science or similar. Ideally, you bring sound knowledge in surface science and/or plasma technology. Creation of own ideas and strong self-motivation is highly desired. Candidates with demonstrated research skills and good publication records will be considered. Fluency in English is required, further knowledge of German (or another language spoken in Switzerland) is a plus. To be considered as a scientist, prior experience of 2-3 years as Post Doc is necessary.

  You will work in an ambitious team combining strong experience in plasma technology, basic research, and established industry contacts. Scientific exchange within the group as well as with further scientists from Empa and other institutes is encouraged.

  ***Your Application:*** Submit your online application at https://apply.refline.ch/673276/1448/pub/1/index.html including a letter of motivation, your CV, a list of publications, diplomas with transcripts, and names of academic referees.

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  Group Leader Plasma & Coating
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- **RF/Plasma Engineer, Lam Research, Fremont, CA, USA**

  Lam Research (www.lamresearch.com) is seeking a highly motivated and extremely inventive hands-on RF/Plasma engineer at the New College Graduate level. The ideal candidate is expected to be knowledgeable in some or all of:

  - RF generator design, transmission line theory, impedance matching.
  - RF filter design, metering and RF power measurement circuit design.
  - RF sub-system / box level design including interface specifications and margin analysis.
  - Cable harness design, documentation, and fabrication.
  - Practical RF engineering design practices such as shielding, power supplies, RF measurements, calibration techniques and signal analysis.
  - Experience with RF measurement equipment such as network analyzers, spectrum analyzers, RF power meters, oscilloscopes, etc…

  ***Preferred qualifications include:***

  - Experience designing, building and trouble-shooting RF and Plasma systems.
  - Familiarity with Plasma Physics and Plasma modeling techniques.
  - Knowledge of plasma diagnostic techniques.
  - Experience with industrial electronics, control systems, and I/O.
  - High voltage power supply design.
  - Experience working with vendors to implement your designs in a timely and cost-effective fashion.
  - Exhibit strong organizational skills, creativity, organizational acumen, and leadership skills.

  ***Qualifications include:***

  - Minimum of MS or PhD in Electrical Engineering, Physics or similar with experience in high power RF design.
  - Application to plasma reactor design and understanding of plasma interactions and issues.
  - Ability to propose innovative solutions, drive to completion, and present to Executive management.
  - Knowledge of the Semiconductor industry, plasma, and capital equipment experience a plus.
  - Strong communication skills and Must be able to work well in a team environment.
  - Exhibit strong organizational skills, creativity, organizational acumen, and leadership skills.

  *Contact:*
  **Dr. Roger Patrick**
  Lam Research, Managing Director
  Roger.Patrick@lamresearch.com

- **Postdoctoral Position, *Laser Induced Fluorescence on Plasmas Interacting with Lipids*, Polytechnique Montréal, Canada**

  A post-doctoral position is available in Montréal, Canada, at the Polytechnique Montréal, Plasma Physics and Spectroscopy Laboratory (PPSL) www.polymtl.ca/plasma. PPSL is directed by Stephan Reuter, Professor at the Department of Physics Engineering and Chair for plasma medicine at the TransMedTech Institute (www.polymtl.ca/transmedtech). Successful applicants should have expertise in laser fluorescence microscopy and spectroscopy, in biophysical models and have an interest or experience in plasmas for medicine. You will work in an interdisciplinary project involving aspects of physics, biophysics, chemistry, and medicine. In this position, apart from your research project, you are expected to contribute to proposal and report writing, and publication of research in conferences and peer reviewed journals. The TransMedTech project offers competitive funding. Your profile:

- You have experience in laser induced fluorescence (TA)LIF, laser fluorescence microscopy and/or biophysical model systems (lipids, liposomes, etc.).
- Ph.D. in physics, biophysics, chemistry, mechanical-, electrical-, biomedical engineering, or a related discipline.
- Excellent theoretical and practical knowledge in one or more of plasma physics and diagnostics, biomedical applications of plasmas, redox biological processes relevant for plasma medicine.
- Outstanding scientific track record demonstrating well-organized design and execution of research.
- Strong communication skills and ability to work independently as well as in a collaborative team.
- Strong motivation to collaborate with researchers in the medical field.
- Your excellent grades should allow you to apply for grants under Canadian funding schemes.

We will especially consider applications of members of equity seeking groups.

You will be employed at Polytechnique Montréal, a francophone engineering University in the heart of Montréal, Québec. You will interact with colleagues within Engineering Physics Department and the Institut Biomédicale of Polytechnique Montréal and Université de Montréal and the TransMedTech Institute and its collaborating research hospitals.

**Application process** in 2 stages**:** Please send your application in a **first application stage** as a **single PDF file** including full CV, University grades, a cover letter describing research interests and goals (max. 2 pages), full list of publications highlighting your most relevant peer reviewed works, contact information of three references. Applications should be sent to **Prof. Stephan Reuter** (stephan.reuter@polymtl.ca) using the subject line **"*PPSL-Postdoctoral Fellow*".** The successful candidate of the first stage must send a full application including a research project to the TransMedTech Institute (1st stage deadline: **5th of Sept. 2021**; 2nd stage full application deadline for the successful candidate: towards **mid/end of September 2021**).

*Contact:*
**Prof. Stephan Reuter**
Polytechnique Montréal
stephan.reuter@polymtl.ca

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

We are looking for interested candidates for a postdoc vacancy that will become available at Max Planck Institute for Plasma Physics, in the group of Plasma for Gas Conversion (https://www.ipp.mpg.de/4282842/P4G). The group is working on the topic of plasma conversion of low energy molecules into value-added chemicals by using low temperature plasmas. The research is contributing to power-to-gas initiative in the field of energy storage, hydrogen technology, and chemical energy carriers. Focus of the group so far is on $CO_2$ conversion using microwave experiments covering the pressure range from low to atmospheric pressure. The group is expanding towards the field of plasma-catalysis (dry methane reforming, ammonia synthesis, etc.), operating both microwave plasmas and dielectric-barrier-discharges (DBD). We are interested to investigate interactions between a plasma and a catalytic surface. Hence, we are looking for a Postdoc candidate with experience in catalysis or material scientist.

It is expected that candidate designs and applies experiments at various plasma conditions and for various catalytic surfaces. Tasks of the candidate will include execution, evaluation and dissemination of the test results with respect to implications for scientific advantage of plasma catalysis. The candidate will identify, plans and define possible in-situ, in-vacuo, and ex-situ experiments for surface analysis. The candidate should have completed doctoral thesis, preferably in the field of plasma chemistry, plasma surface interaction, or catalysis. Experience in chemical reaction engineering, thermal and plasma catalysis, plasma chemistry is preferred. Strong ability to interpret experimental data and very good communication skills and ability to present scientific results are required.

This is a position for 3 years intended to be available from 1 October 2021 or as soon as possible thereafter. Applicants should send a cover letter (including date applicant is available), CV, and reprints of representative publications to **Prof. Ursel Fantz** (ursel.fantz@ipp.mpg.de).

*Contact:*
**Dr. Ante Hecimovic**
Plasma for Gas conversion (P4G) Group
Max-Planck-Institute for Plasma Physics, Germany
ante.hecimovic@ipp.mpg.de

- **Postdoctoral Experimental Physicist for Diagnostics of Large Negative Ion Beams, Max-Planck-Institut für Plasmaphysik, Munich, Germany**

The ITER Technology & Diagnostics (ITED) group of the Max-Planck-Institut für Plasmaphysik (IPP), Munich, Germany, is looking for a Postdoctoral Experimental Physicist for Diagnostics of Large Negative Ion Beams. This position will be until 31 December 2024.

The main responsibilities of the role will be to operate, maintain, and interpret beam diagnostics at the negative ion beam test facilities BATMAN Upgrade and ELISE. These are negative ion sources using an RF driven low temperature plasma to create a large beam of negative ions, up to 1 m × 1 m in cross-section. The goals of this project are to improve understanding of negative ion beam formation and transport, as well as further development of the beam diagnostics themselves, including IR-thermography of a CFC calorimeter and beam emission spectroscopy. You will also be expected to work with international experts in the field in both ongoing and future collaborations. Candidates should have:

- Completed studies and a doctorate in physics or equivalent fields
- Solid knowledge of data acquisition systems, data evaluation and visualization
- Experience in the operation of ion sources and beams is an advantage
- Good knowledge of IR-thermography, calorimetry, or emission spectroscopy is an advantage

As a candidate you must be able to:

- Fluently present complex scientific and technical matters in English
- Show good organizational, interpersonal and communication skills
- Work in a scientific environment as part of a team
- Work in and collaborate with international teams

For more information, or to apply, please visit the IPP Careers Portal (https://www.ipp.mpg.de/job-68461b0832c924b468953324a424cdd0?c=17953).

*Contacts:*
**Prof. Ursel Fantz**, ursel.fantz@ipp.mpg.de
**Dr. Andrew Hurlbatt**, andrew.hurlbatt@ipp.mpg.de
Max-Planck-Institut für Plasmaphysik, Germany

- **Head of Research Program in Bioactive Surfaces, Leibniz Institute for Plasma Science and Technology (INP), Greifswald, Germany**

We are seeking to hire at the Leibniz Institute for Plasma Science and Technology (INP) in Greifswald, Germany, Head of Research Program in Bioactive Surfaces starting at the earliest possible date (http://www.inp-greifswald.de/). You will be responsible for the scientific and administrative management of the research program 'Bioactive Surfaces'. You will lead and be a part of a highly motivated team of scientists, engineers and technicians in the fields of physics, chemistry, biology, materials science and materials technology. Current research activities include the development of plasma-supported processes for the modification of surfaces and materials for applications in the following areas: Medical technology,

biotechnology and diagnostics. The spectrum of your tasks ranges from basic and applied research to technology transfer in industry, which includes:

- Development of the research program with focus on attractive scientific and application-oriented topics. There may be the chance to set up a junior research group. For this, please suggest appropriate topics in your application.
- Open up new industrial fields of application.
- Apply for appropriate third-party funding from the public sector and industry.
- Develop and maintain contacts with domestic and foreign institutes and industrial cooperation partners.
- Management of ongoing projects in cooperation with the project leaders.
- Commitment to your own research activities.

***Your profile:***

- Successfully completed university PhD studies preferably in physics, chemistry, biology, engineering, materials science, environmental science or comparable subject areas.
- Experience and knowledge in the area of surface modification are necessary.
- Several years of leadership and project management experience.
- Proven expertise through project work and publication.s
- Industry experience is an advantage.
- High level of commitment.
- Proven experience in acquiring third-party funding.
- Very good knowledge of German and English.
- Very good organizational skills and a hands-on mentality.
- Excellent communication skills and ability to work in a team, as well as creativity.

Please apply (motivation letter, CV, copies of academic degrees) giving the keyword **"0426 Head of Research Programme Bioactive Surfaces"** until **15th September 2021.** Please present your academic and professional career in the letter of motivation and describe your future research projects. We would also like to receive a list of your most important publications and your previous third-party funding. Send applications to: Mrs. Gabriele Lembke, Human Resources Department, bewu@inp-greifswald.de.

*Contact:*
**Prof. Klaus-Dieter Weltmann**
Chairman of the Board and Scientific Director
weltmann@inp-greifswald.de

- **Intern - Applied Optical & Plasma Science - R&D Graduate Year-Round, Sandia National Laboratory, Albuquerque, NM, USA**

Our team at Sandia National Laboratory is seeking a Year Round Graduate Student Intern to conduct research on low temperature plasma chemistry. You will use state-of-the-art computational tools and clusters to develop new scientific insights and aid Sandia in its mission to serve the nation. In collaboration with computational staff members, you will develop reaction mechanisms for non-equilibrium plasma chemistry and validate computational models to enable predictive design and to investigate fundamental phenomena. Key functions of this role include, but are not limited to:

- Developing plasma chemistry reaction mechanisms.
- Reviewing relevant literature for reaction rates and cross sections in non-equilibrium systems.
- Developing test problems for plasma chemistry models and analyzing the resulting data.
- Leveraging existing plasma simulation tools for new applications.
- Establishing new scientific insight on the physical mechanisms underlying LTP phenomena.
- Publication of scientific results and participation in the scientific community.

- Validation and verification of plasma simulation tools in collaboration with experimentalists

***Qualifications we require:***

- Earned bachelor's degree and currently enrolled full time in an accredited science, engineering, or math graduate program.
- Minimum cumulative GPA of 3.0/4.0.
- Work up to 30 hours/week during the academic year, and up to 40 hours per week during the summer.
- U.S. citizenship.

***Qualifications we desire:***

- Good communication and interpersonal skills.
- The motivation and ability to tackle technical problems independently.
- Interest in or experience developing non-equilibrium plasma chemistry models.
- Proficiency in scientific programming in some language (e.g., C++, Python).
- Experience in model and algorithm development for computational simulation.
- Experience working with HPC platforms.

The Low Temperature Plasma Physics thrust has ongoing work in sheath physics, plasma chemistry, plasma-surface interactions, arc discharges, high energy electron beams, and more. We possess both experimental and computational experts that work together to produce new understanding. The plasma codes we use include fully kinetic, hybrid, and fluid models. Experimentally, we have developed a variety of plasma sources and use a variety of diagnostics to examine these systems. There may be an opportunity for this position to perform experimental work directly, in addition to the primary modeling work.

***Apply link:***
https://cg.sandia.gov/psc/applicant/EMPLOYEE/HRMS/c/HRS_HRAM_FL.HRS_CG_SEARCH_FL.GBL?Page=HRS_APP_JBPST_FL&Action=U&FOCUS=Applicant&SiteId=1&JobOpeningId=677277&PostingSeq=1&SiteId=1

*Contact:*
**Dr. Amanda Lietz**
Sandia National Laboratory
amlietz@sandia.gov

- **Post-doctoral Research Position in Plasma Physics, Auburn University, Auburn, Alabama, USA**

A post-doctoral research position in experimental plasma physics is immediately available in the Magnetized Plasma Research Laboratory at Auburn University (http://webhome.auburn.edu/~thomaed/mprl/index.html). This position will involve the design, operation, and diagnosis of low temperature plasma experiments that focus on the transport and stability of magnetized and unmagnetized plasmas. Experiments will be performed using tabletop devices and in the Magnetized Dusty Plasma Experiment. Additional studies will involve the interaction of high frequency electromagnetic waves with magnetized and unmagnetized plasmas. For these some of these projects, US citizenship is a requirement.

*Contact:*
**Prof. Edward Thomas Jr.**
Auburn University, USA
etjr@auburn.edu

- **Post-doctoral Position in Plasma-Materials Science at the University of Minnesota, USA**

  A post-doctoral position is available in the group of Professor Uwe Kortshagen, which is part of the High Temperature and Plasma Laboratory in the Department of Mechanical Engineering at the University of Minnesota in Minnneapolis, Minnesota, USA.

  Kortshagen's group is known for the synthesis of nanomaterials with low temperature plasmas. Materials studied include semiconductor quantum dots, ceramic nanomaterials, and metal nanoparticles for applications in renewable energy generation, electronic and photonic materials, energy storage and energetics. The post-doctoral researcher is expected to contribute to multiple projects and take leadership in mentoring Ph.D. and M.S. level graduate students and undergraduate students.

  ***Desirable qualifications include:***

  - A strong background in experimental low temperature plasma science, including design and operation of plasma reactors, familiarity with plasma diagnostics, and a solid basic understanding of low temperature plasmas.
  - Willingness to work in teams with graduate and undergraduate students.
  - Strong written and verbal communication skills.
  - Familiarity with materials characterization techniques such as X-ray diffraction, electron microscopy, X-ray photo electron spectroscopy, and Fourier transform infrared spectroscopy is desirable but not required.

  Formal applications need to be submitted through the University of Minnesota Human Resources system under Job ID 341592 (https://hr.myu.umn.edu/jobs/ext/341592).

  *Contact:*
  **Prof. Uwe Kortshagen**
  University of Minnesota, USA
  kortshagen@umn.edu

- **Electrical Engineering Lead, Clean Crop Technologies, Holyoke, MA, USA**

  Clean Crop Technologies, Inc. (https://cleancroptech.com) is a VC-backed agtech startup building the next generation of food preservation and treatment technologies based on our proprietary cold plasma technology platform. Our core tech is an electro-chemical ionization process which combines electricity and air to breakdown micro-organisms and toxins which lead to food waste and consumer health challenges around the globe.

  The Electrical Engineering Lead is a new senior management position focused on tackling complex and critical technical challenges related to optimizing plasma gas ionization systems efficiency and process integration into a productized system for use in a food processing environment. While focused on the core tech development, the EE Lead is expected to take part in driving innovation and establishing prioritizes across the company. At the intersection of core R&D and product development, the role is an exciting and challenging opportunity to combine electrical engineering experience with life sciences.

  ***Responsibilities:***

  - Lead R&D efforts related to electrical system design and fabrication
  - Manage optimization studies for plasma reactor and sub-assemblies
  - Oversight of workplace operating conditions and safety related to High Voltage power supplies
  - Training and management of R&D personnel for use of high voltage systems and diagnostic equipment
  - Troubleshooting and ruggedization of electrical components used in R&D and product development.
  - Manage data acquisition and validation studies related to electrical diagnostics and optimization
  - Vender management for projects related to power supply, electrical equipment and fabrication projects.
  - Support process engineering team design DoEs and electro-chemical trials.

- Identification of competitive cost saving acquisitions and IP development
- Serve as a company representative during engagements with industry partners and prospective R&D or commercial collaborators.

***Qualifications:***

- MS or Ph.D in Electrical Engineering, or Physics (Focus on Energy and High Power Systems, Signal Processing or Control Systems preferred)
- Background in programming or management of Programmable Logic Controls (PLC) is preferred
- Experience in modelling or design of electrical systems
- Comfortable operating in a rapid prototyping and hands-on R&D work place.
- Strong understanding of electrical engineering concepts such as DG, storage, reliability, load flow, flicker, stability, short circuit, voltage regulation, transients, power factor, losses, etc.
- Strong technical understanding of the parameters and functions used in the operation of the power delivery system as well as power industry fundamentals, practices, and standards
- Knowledge and experience using power system modeling and simulation software for steady state power flow, voltage, short circuit, stability, and electromagnetic transients.
- Creative thinker with a focus on problem solving
- Strong communication skills and presenting experiment data and results.

*Contact:*
**Dr. Daniel Cavanaugh**
Clean Crop Technologies, Chief Operating Officer
daniel@cleancroptech.com

- **R&D Associate Junior Engineer, Clean Crop Technologies, Holyoke, MA, USA**

Clean Crop Technologies, Inc. (https://cleancroptech.com) is a VC-backed agtech startup building the next generation of food preservation and treatment technologies based on our proprietary cold plasma technology platform. We are seeking a hands-on engineer or data scientist associate to join our team! Under the direction of the R&D management team, the associate will be an important role player in running daily R&D trials, designing and fabricating important components used in prototypes. This is an exciting opportunity to come in on the ground floor and help innovate in a fast-paced environment at our Holyoke, Massachusetts facility. The selected individual will work in a team environment that requires excellent communication and interpersonal skills.

***Responsibilities:***

- Design key components and systems to be used in upcoming prototypes or related R&D facilities.
- Manage CAD designs, power supply circuitry and support design leads on BOM, inventory and procurements related to upcoming builds.
- Conduct independent research on electrical engineering methods and strategies for use in R&D trials.
- Ensure facilities meet company protocols for worker safety and quality control.

***Qualifications:***

- Fluent or high aptitude for CAD design software (Autodesk, Solidworks preferred).
- Degree in Mechanical Engineering, Industrial Design, Electrical Engineering, Physics or Data Sciences preferred.
- Hard working, goal oriented, and ability to manage multiple tasks in a fast pace work environment.

*Contact:*
**Dr. Daniel Cavanaugh**
Clean Crop Technologies, Chief Operating Officer
daniel@cleancroptech.com

## Collaborative Opportunities

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

***Disclaimer***

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