LANGMUIR PROBE SYSTEM
Microwave Plasma Applications

Measure the fundamental plasma parameters with the industry standard Langmuir Probe

https://www.impedans.com/langmuir-probe

Impedans
PLASMA MEASUREMENT

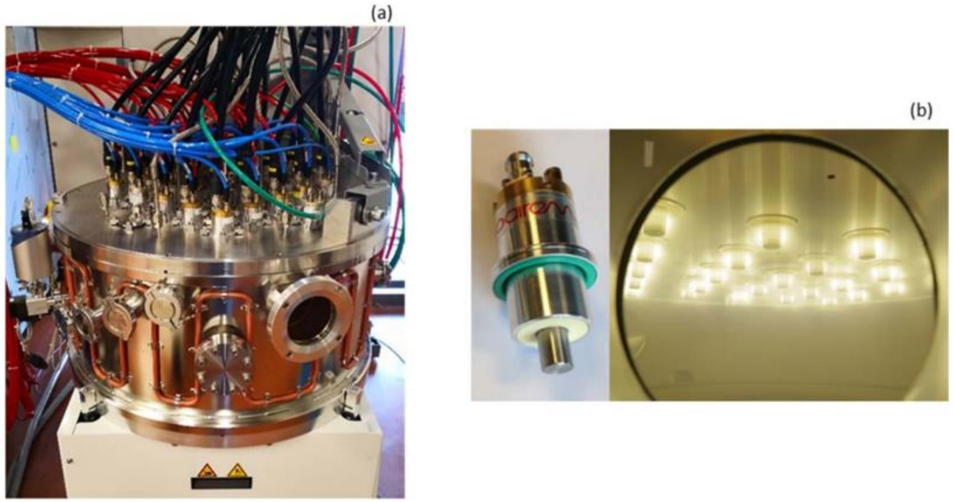
Investigation of the performances of the microwave plasma source ‘Aura-wave’

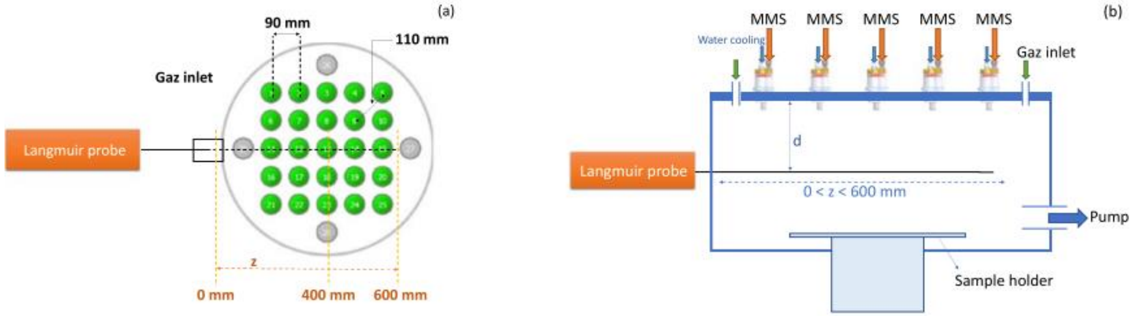
Distributed elementary ECR microwave plasma sources supplied by solid state generators for production of large area plasmas without scale limitation: plasma density measurements and comparison with simulation

DOI: https://doi.org/10.1088/2516-1067/ac0499

In this work, novel, self-matched plasma sources using microwave solid state generators have been developed. The reactor permits the integration of 25 SAIREM Aura-Wave plasma sources.
Every source is connected to its own microwave module solid state generator(SAIREM MMS450) which can deliver a maximum power of 450 W.

The setup shown on the right and some example data is shown on the following slides

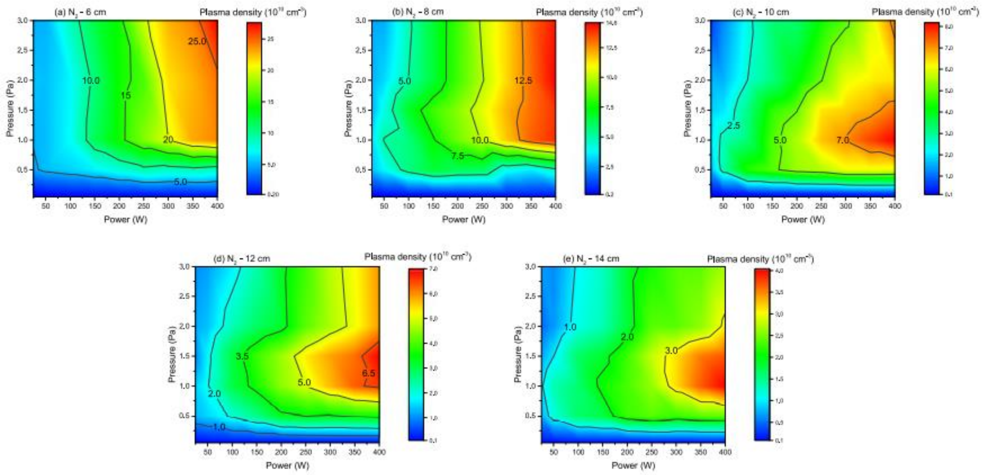




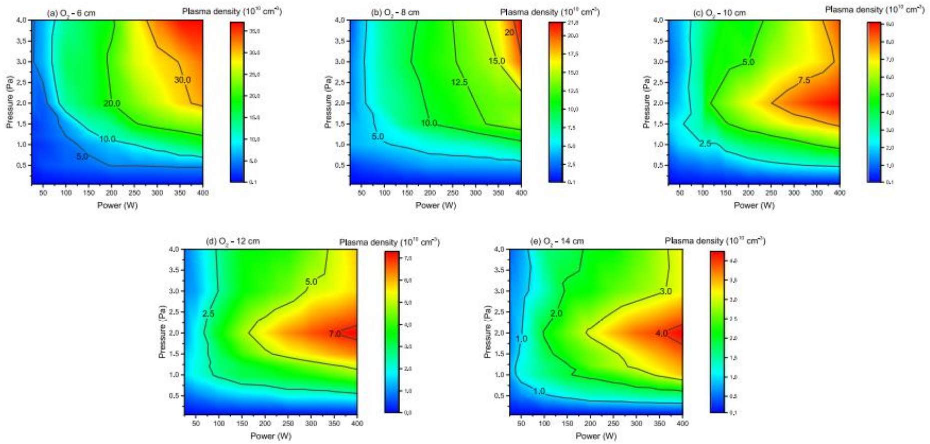
Picture of the plasma reactor with 25 Aura-Wave sources and an oxygen plasma generated by 25 sources with 10 KW total microwave power.

Investigation of the performances of the microwave plasma source ‘Aura-wave’

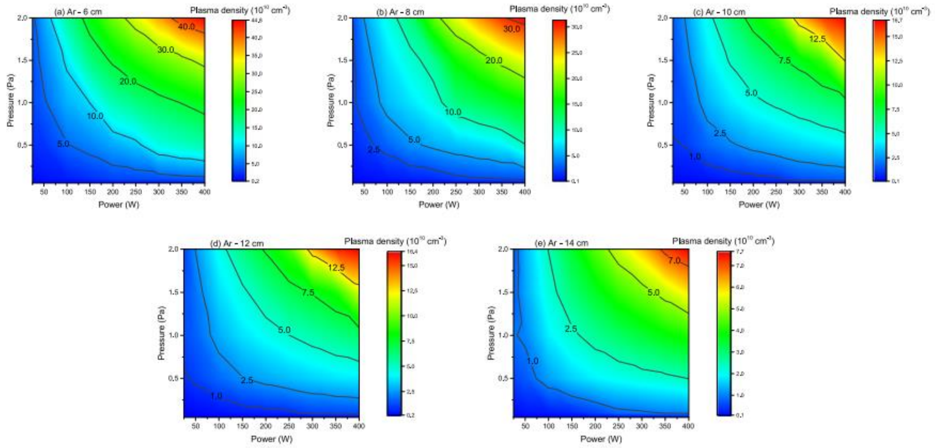
For a pure nitrogen plasma.



For a pure oxygen plasma.

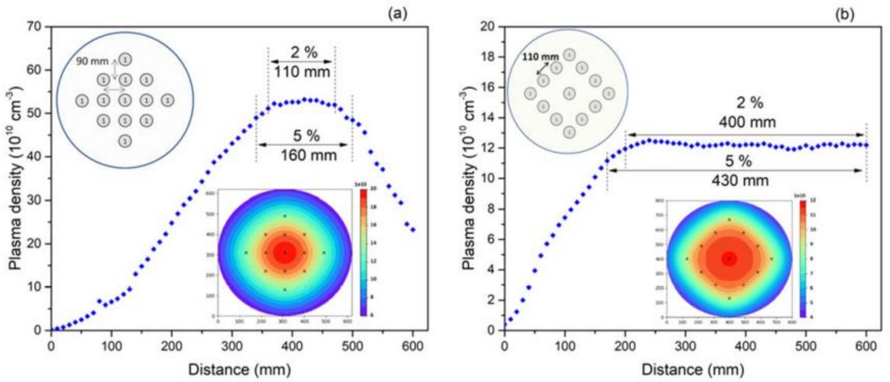


For a pure argon plasma.

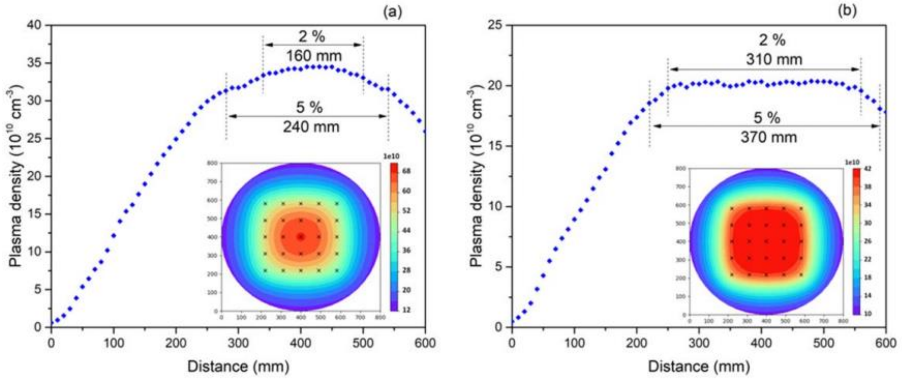


N_e as a function of power and pressure at (a) 6 cm, (b) 8 cm, (c) 10 cm, (d) 12 cm and (e) 14 cm in front of the center of the Aura-Wave plasma source. The density profile from Langmuir probe was integrated in the simulation software and projected in the 2D plan at the distance of acquisition.

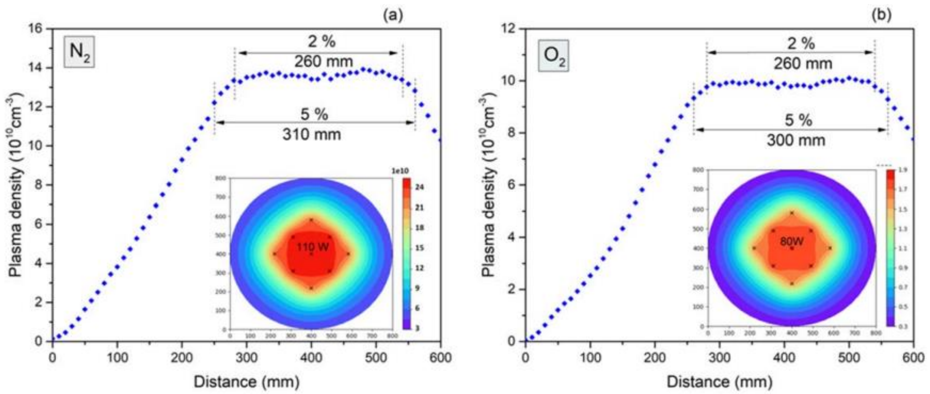
Investigation of the performances of the microwave plasma source 'Aura-wave'



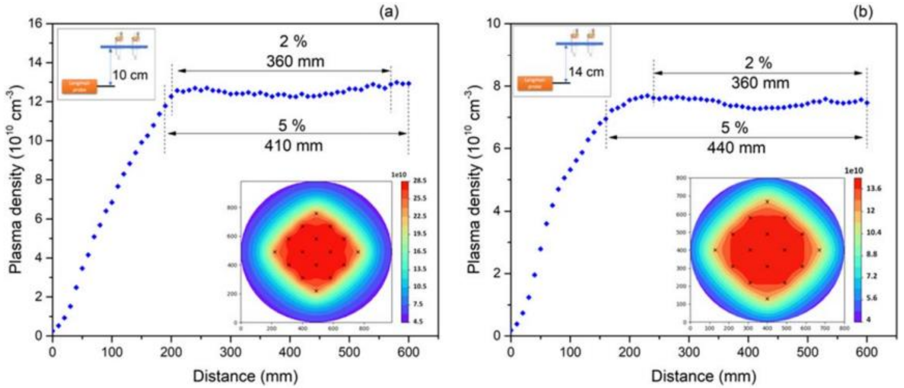
Simulated and measured density profiles for argon plasma at 0.5 Pa, 400 W/source (5.2 kW total power) obtained at 14 cm with 13 Aura-Wave sources distributed in(a) quasi matrix configuration and (b) optimised configuration.



(a) Simulated and measured density profiles for a matrix of 25 Aura-Wave, a = 90 mm, d = 10 cm, N_2, 1 Pa,(a) 400 W/ peripherical sources and 400 W/central sources(10 kW total power) and (b) 400 W/peripherical source and 75 W/central sources (7.075 kW total power).



Simulation and experimental density obtained with a matrix configuration of(3 × 3) Aura-Wave with lattice parameter a = 110 mm, at 10 cm from source plane at 1 Pa for(a) Nitrogen plasma (3.31 kW total power) and (b) Oxygen plasma (3.28 KW total power).



2D simulation and Langmuir measurements of the plasma density distribution for a matrix configuration of 16 Aura Wave, a = 110 mm, for nitrogen plasma at 1 Pa, 400 W/peripherical sources, 150 W/central sources(5.4 kW total power) (a) at 10 cm, (b) at 14 cm from the source plane

Impedans
PLASMA MEASUREMENT

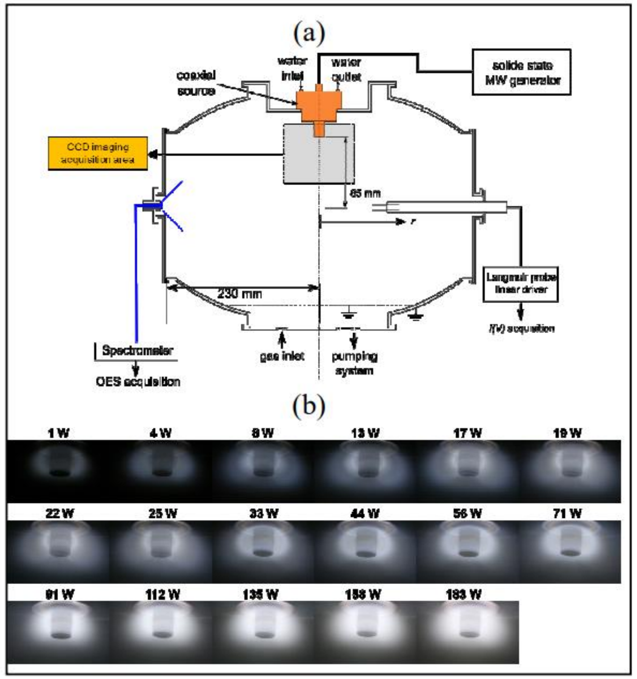
Performance of ECR 'Aura Source' using Langmuir probe

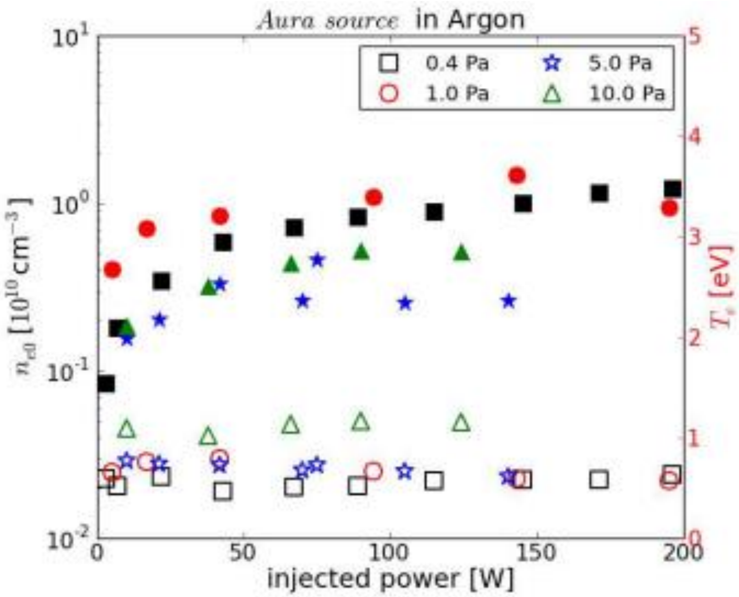
2.45 GHz ECR coaxial plasma source: characterization in single and multi-sources configuration

DOI: [Guillot_8Lowpressureplasmas (uaic.ro)]

In this work, an extensive study was conducted on an ECR coaxial plasma source by Langmuir probe. ECR coaxial source called Aura source is studied here where two magnets were used instead of one in order to obtain larger ECR surface, thus achieving uniform plasmas more easily.

Some example data is shown to the right.





Experimental setup and spatial distribution of plasma parameters as a function of injected power.

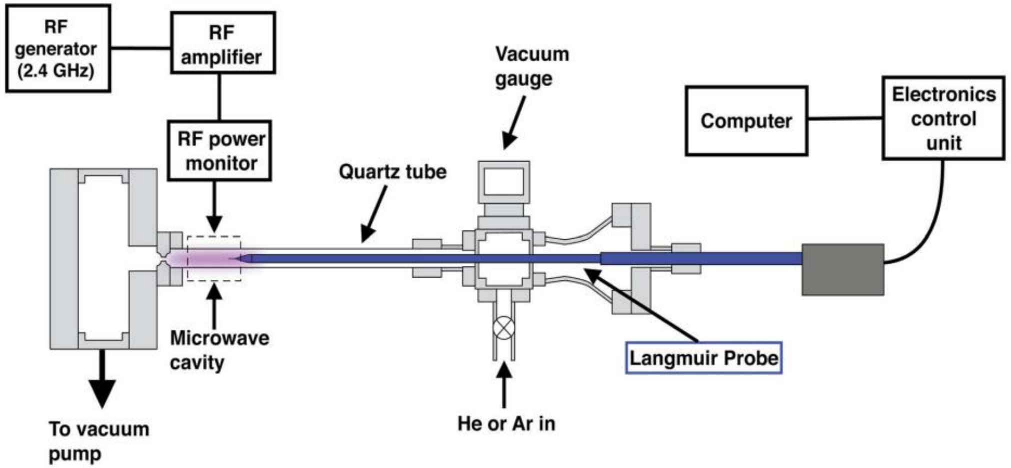
Capability of microwave induced plasmas (MIPs) to ionise refractory elements and macro-molecular organics

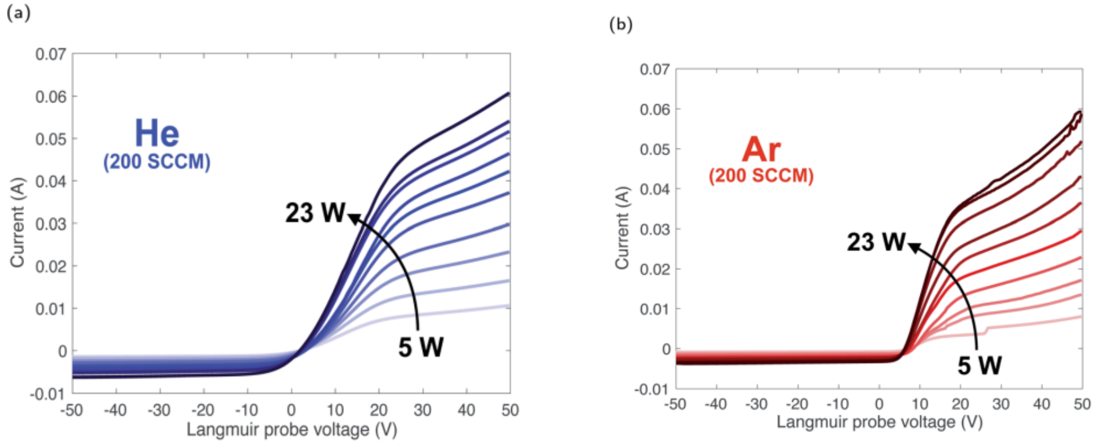
A prospective microwave plasma source for in situ spaceflight applications

DOI:
https://pubs.rsc.org/en/content/articlepdf/2020/ja/d0ja00198h

In this work, investigation is carried out using argon and helium gas supplies, regarding the fundamental characteristics of low power and reduced-pressure microwave plasmas for organic and elemental analysis.
These plasmas require a fraction of the power (<25 W) and gas (<0.2L min^{-1}) compared to conventional ICP.

Some example data is shown to the right.

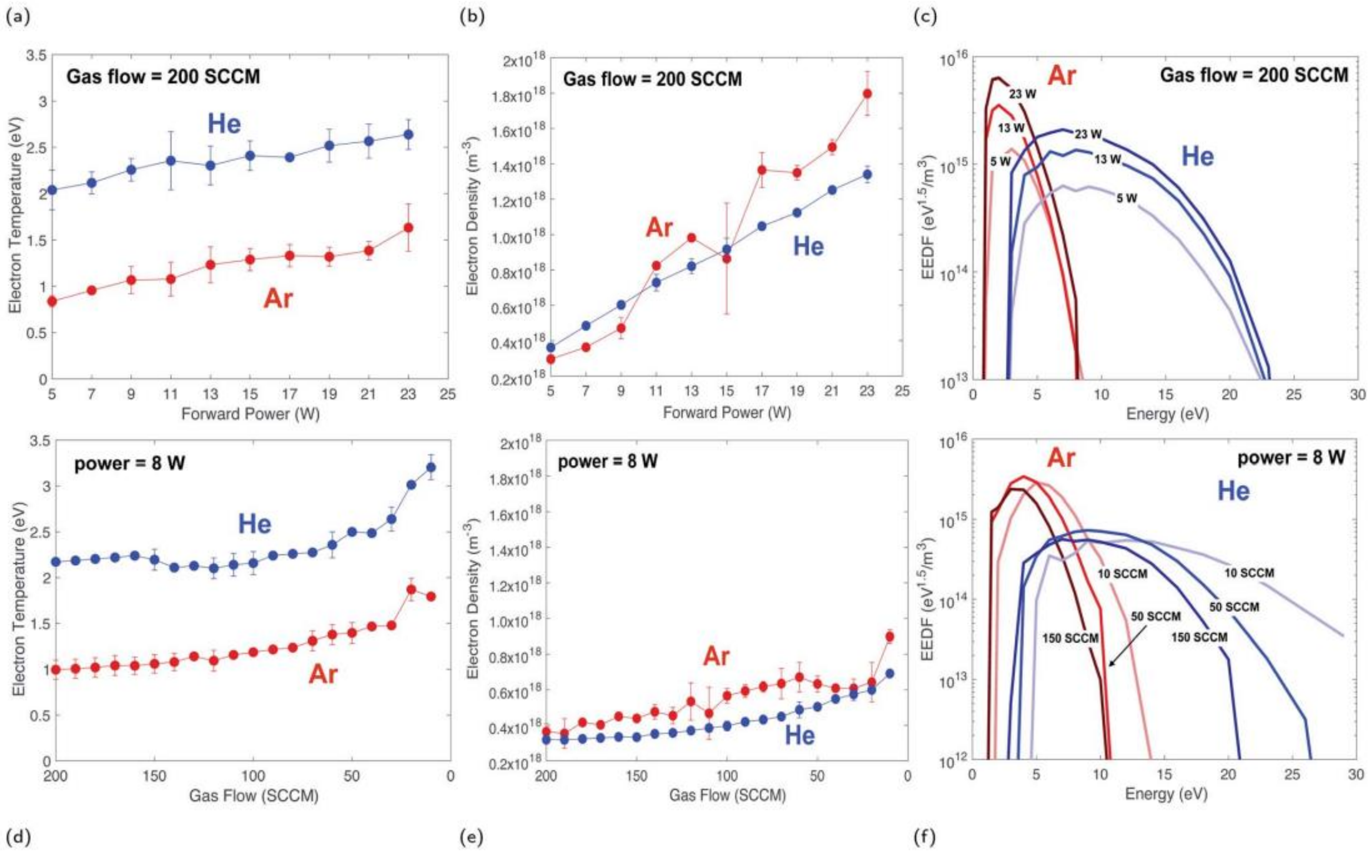




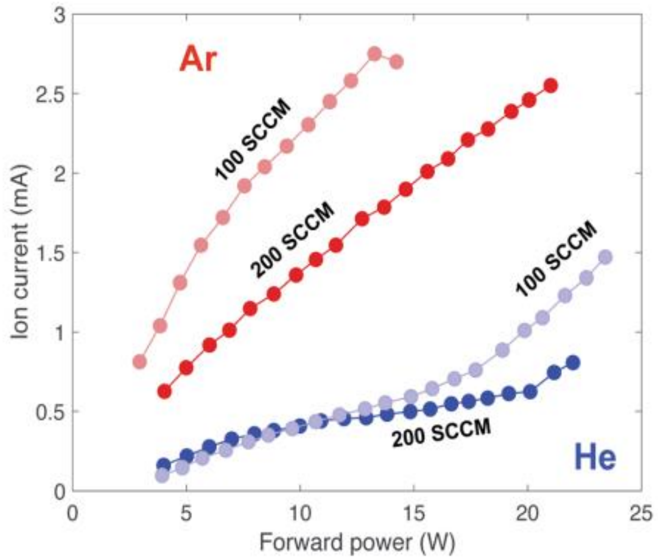
Experimental setup: A signal generator (Hewlett Packard, 8648C): 2.3–2.45 GHz enhanced by a RF amplifier (Mini-Circuits, ZHL-30-252-s+) is used. IV Characteristics at constant gas flow rate.

Impedans PLASMA MEASUREMENT

Capability of microwave induced plasmas (MIPs) to ionise refractory elements and macro-molecular organics



Electron temperature (Te) and electron density (Ne) results of Langmuir probe measurements as a function of plasma power (a–c) and gas flow rate (d–f), as well as electron energy distribution (EEDF) measured for select values for plasma power and gas flow rate.



Ion current versus forward power taken with a -20 V static voltage potential.

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PLASMA MEASUREMENT

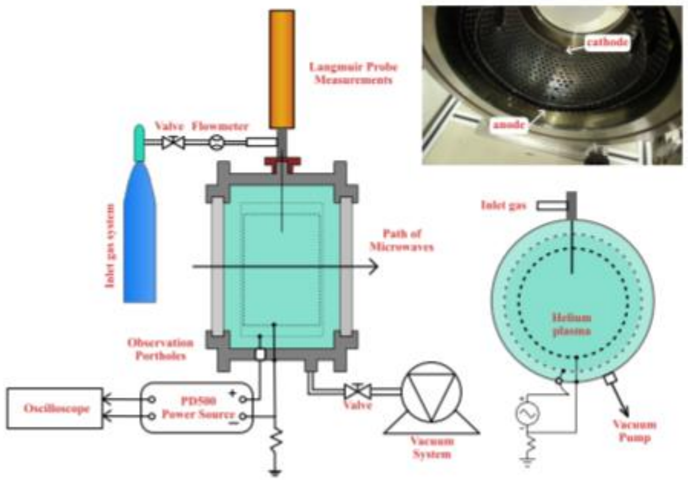
Characteristics of a novel, large volume, coaxial gridded hollow cathode helium plasma

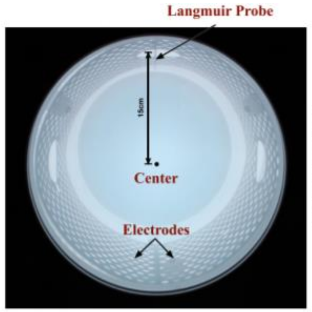
Broadband microwave propagation in a novel large coaxial gridded hollow cathode helium plasma

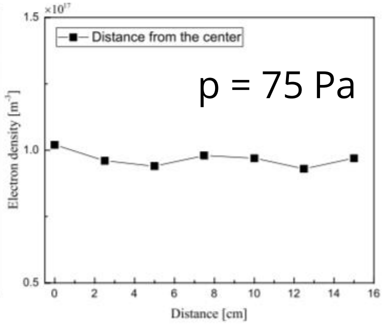
DOI: http://dx.doi.org/10.1063/1.4954393

In this work, a large volume coaxial gridded hollow cathode helium plasma was designed and the basic parameters of this plasma generator were measured using a Langmuir probe of Impedans Ltd.
The propagating characteristics of the broadband microwave were analysed using a Keysight vector network analyser and horn antennae with receiving frequency 2–18 GHz.

Some example data is shown to the right.







P (Pa)	n_e (10^{16} m^{-3})	T_e (eV)	ν_c (GHz)	ω_p (GHz)
15	4.48	4.63	0.49	1.90
35	6.51	3.51	0.99	2.29
55	8.95	3.16	1.48	2.69
75	9.97	3.02	1.98	2.83

Experimental setup and plasma characterisation at different helium pressures.

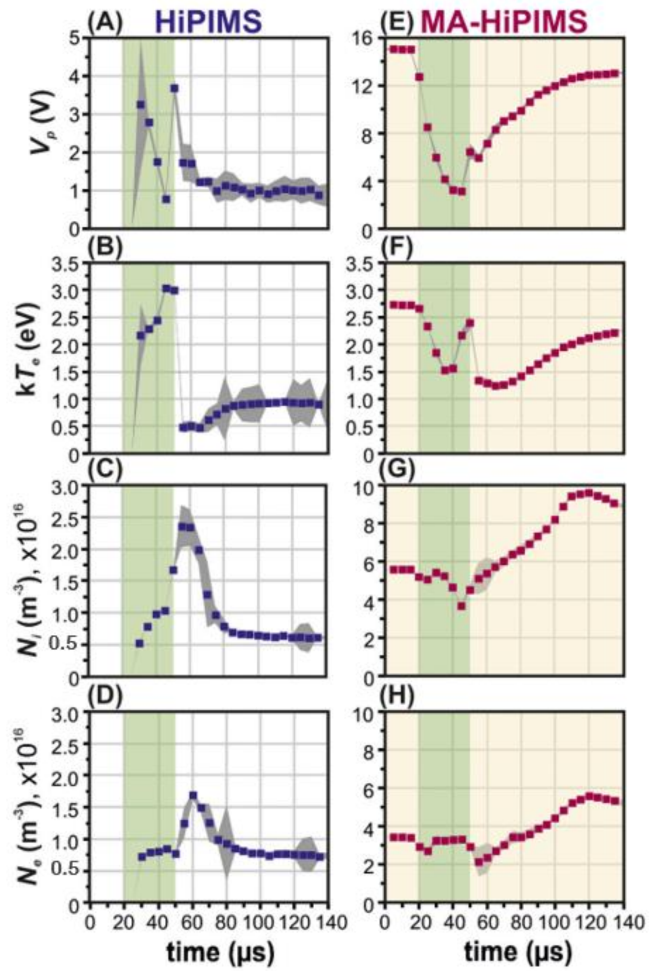
Correlation between plasma conditions and the properties of the fabricated DLC films

From pulsed-DCMS and HiPIMS to microwave plasma-assisted sputtering: Their influence on the properties of diamond-like carbon films

DOI: https://doi.org/10.1016/j.surfcoat.2021.127928

This work focuses on investigating the influence of pulsed-direct current MS (pDCMS), high power impulse magnetron sputtering (HiPIMS) and their microwave plasma-assisted (MA-pDCMS, MA-HiPIMS) variants on the properties of the fabricated DLC films.

Some example data is shown to the right.



Langmuir probe parameters under: (A–D) HiPIMS and (E–H) MA-HiPIMS DLC sputtering conditions. Green areas mark pulse duration (30 μs), yellow areas mark the period when only the microwave plasma is on.

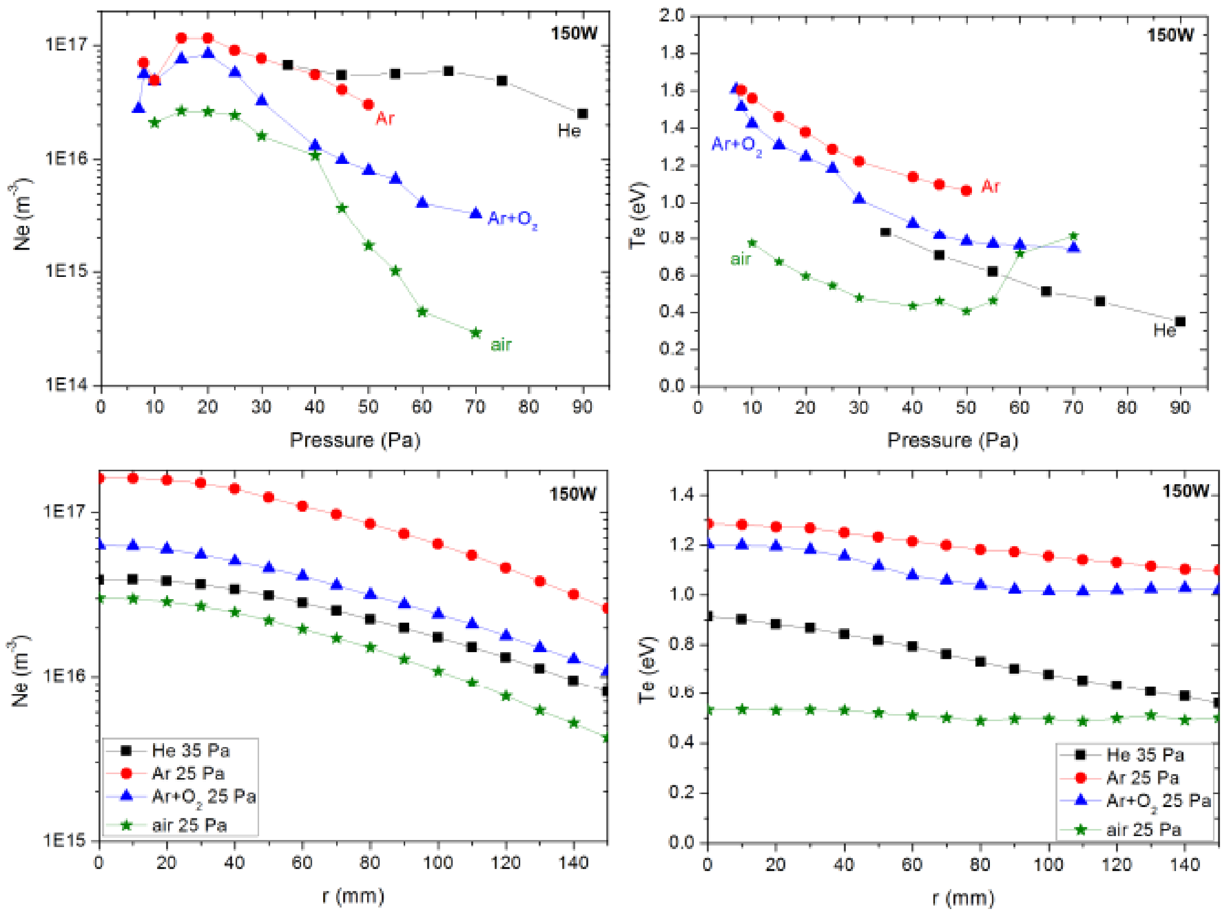
Performance of the coaxial source and the optimal plasma conditions for an efficient decontamination of food products

Characterization of a low-pressure microwave collisional-type coaxial plasma source used for decontamination in food industry

DOI:
https://www.researchgate.net/publication/317888829

This work focuses on characterisation of a single low-pressure microwave 2.45 GHz coaxial plasma source prior to large scale food decontamination process. The operating operates in a restricted pressure range (10^{-2} mbar to 10^{-1} mbar).

Some example data is shown to the right.



Plasma density and electron temperature as a function of gas pressure and radial position with 150 W net power injected.

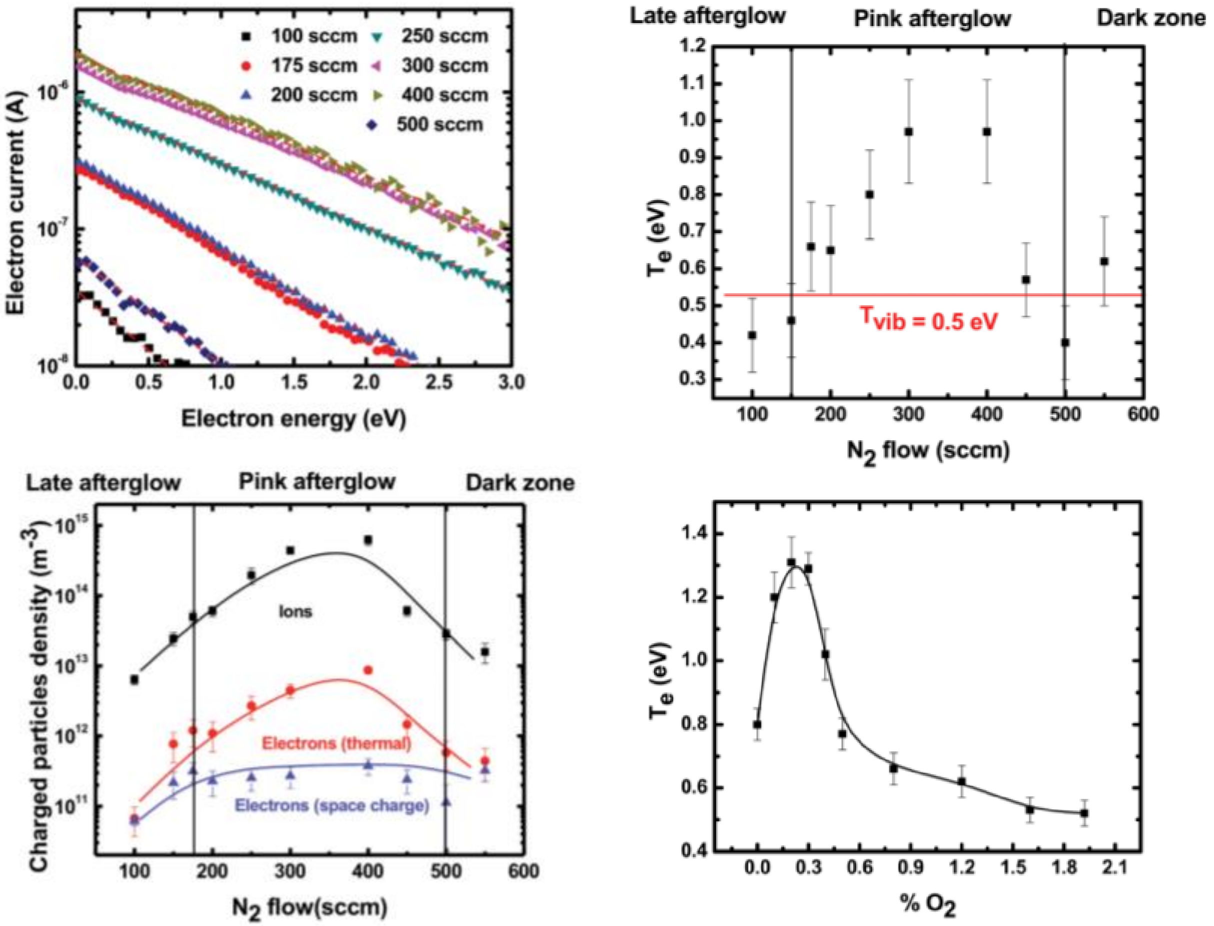
Characterisation of N_2/O_2 plasma sustained by an electromagnetic surface wave at 2.45 GHz

Electrical characterization of the flowing afterglow of N_2 and N_2/O_2 microwave plasmas at reduced pressure

DOI: http://dx.doi.org/10.1063/1.4872468

In this work, Impedans Langmuir probe was used to analyse the spatial distribution of the number density of positive ions and electrons as well as the electron energy distribution function (EEDF) in the flowing afterglow of a 6 Torr N_2 and N_2/O_2 plasma sustained by a propagating electromagnetic surface wave in the microwave regime.

Some example data is shown to the right.



Example of plasma parameter characterisation a microwave plasma operated in N_2/O_2.

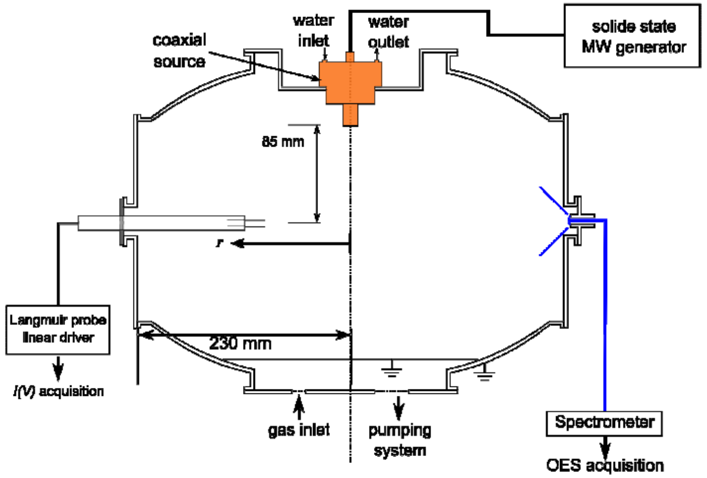
Study suggesting pressure does not influence the inactivation of B. atrophaeus spores

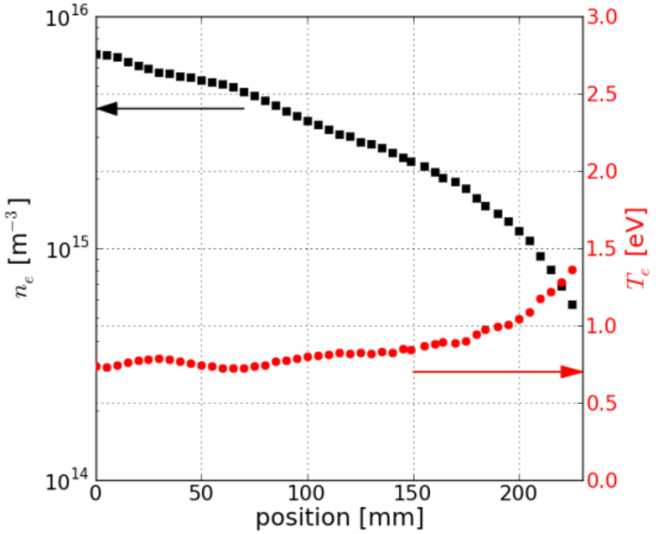
Investigation of bacterial spore inactivation using a 2.45 GHz coaxial plasma source

DOI: [C Muja 16 (uaic.ro)]

The aim of this work was to assess the influence of gas pressure on the inactivation kinetics and cell morphology of B. atrophaeus spores exposed to the plasma generated by a low pressure electron cyclotron resonance (ECR) plasma source.

Some example data is shown to the right.





Experimental setup and spatial distribution of plasma parameters at 1 Pa and 150 W

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