Science Fund of the Republic of Serbia – Program IDEAS

Project Acronym: APPerTAin-BIOM

Project title: Atmospheric pressure plasmas operating in wide frequency range – a new tool for production of biologically relevant reactive species for applications in biomedicine

DATA MANAGEMENT PLAN

July 2022

1. Data Summary

1.1. Atmospheric pressure plasma sources related data

Purpose of data collection/generation

Experimental and modelling data will be collected in order to characterize in detail three plasma systems that operate at atmospheric pressure. The collection of data will be related to the plasma characterization and discharge parameters for plasma treatments. This will include obtaining plasma system parameters by experimental measurements and modelling (voltage, current, deposited power, frequency, gas flow, optical spectra, spatial profiles-imaging, distance from the sample, etc.), treatment time and liquid sample physico-chemical characterization (pH, determination of reactive species by colorimetric technique, etc.).

Data will originate from the experimental measurements and modelling of equivalent electrical circuits. It will include characterisation and optimization of the plasma systems: (i) Plasma Needle @13.56 MHz, (ii) DBD plasma jet APP sources @kHz (CW and pulsed), (iii) Surfatron @2.4 GHz. The characterisation will include electrical and optical characterisation in order to define the optimal plasma treatment parameters. Home-made and commercially available electrical probes will be used for electrical characterisation and spectrometer, fast ICCD (Intensified Capacitively Coupled Device) imaging system will be used for optical characterisation. Detailed mass spectrometry measurements will be conducted for all sources operating at selected conditions that provide effective production of reactive species in order to obtain information about the plasma chemistry.

Format

Data regarding plasma treatment parameters (like gas flow, , time, deposited power etc.) will be stored as Excel tables. Current and voltage waveforms of optimized processeswill be stored as CSV together with the metadata (PDF) containing the measurements procedures and data processing procedures. Optical Emission Spectra and mass spectra for the optimized discharge parameters will be stored as CSV with complementing metadata (PDF) with measurement procedures and detector properties.

Data utility and reuse

Data may be used for designing and defining optimal operational conditions of plasma treatment and future potential, with their primary users being process modellers and research community.

The lists of specific parameters and their format are given in Table 1. and Table 2.

Table 1. Parameters related to APPJ

Characterisation of Atmospheric pressure plasma jets		
Electrical characterisation	*Parameters*	*Type of data*
Current-Voltage characteristics	$V_{RMS}=f(I_{RMS})$	CSV
Current and voltage waveform	v=f(t), i=f(t)	CSV
Charge-Voltage characteristics	Q=f(v)	CSV
Power characteristics	$P_{mean}=f(V_{RMS})$	CSV
ICCD imaging	*Parameters*	*Type of data*

Integrated plasma images	Image of plasma emission=f(V_{RMS})	CSV
Integrated plasma images-filtered wavelengths	Image of plasma emission=f(V_{RMS})	CSV
Optical emission spectra -OES	*Parameters*	*Type of data*
Plasma OES	Spectra=f(V_{RMS})	CSV
Mass spectrometry	*Parameters*	*Type of data*
Plasma mass spectrum	Counts=f(m/z)	CSV

*RMS – root mean square; *v, V – voltage; i, I – current; Q – charge; t – time; T – period;

Table 2. Parameters related plasma treated samples

Characterisation of plasma-treated samples		
Characterization method	*Parameters*	*Type of data*
UV/VIS spectrophotometry	Concentration=f(treatment time)	CSV
pH, conductivity, dO	pH, EC, dOdata	CSV
Thermoprobe	Temperature=f(treatment time)	CSV
Volume	Volume=f(treatment time)	CSV

*dO – dissolved oxygen, EC – electrical conductivity;

1.2. Antibacterial plasma treatmentsrelated data

Purpose of data collection/generation

To assess plasma antibacterial efficacy that will lead to the identification of the main plasma-derived reactive species responsible for activated mechanisms in the cells. The data will be also used to assess the possible bacterial resistance developed against plasma treatments and to compare influence of the plasma derived chemistry with conventional antibacterial agentson the bacterial resistance.

Format

The parameters related to microorganisms (cell concentration-CFU count, cell viability) will be measured before and after treatments with plasmaand conventional antibacterial agents. The data will be stored as tables(CSV format) together with the metadataon analytical methods adopted (PDF). In the same manner also treatment conditions (operating conditions) will be provided.

Data utility and reuse

Data may be used in further studies on plasma antibacterial performance and evaluation of possible development on bacterial resistance. Potential users are research community releted to plasma applications and medical researchers.

The list of specific parameters and their format are given in Table 3.

Table 3. Parameters related to bacterial cells

Test organisms: Klebsiella pneumoniae and Enterococcus faecium		
Parameter	*Assessment procedure/Values*	*Type of data*
Bacterial cell concentration	108 CFU/ml - 104 CFU/ml	CSV

Inhibition zone after plasma treatments	circular bacteria-free zone in the homogeneous growth on the agar surface after 24 h, 48 h and 72h incubation (mm and mm2)	CSV
Antibacterial activity of plasma by CFU count	≥ 50% and > 90% reduction compared to theuntreated control	-
Bacterial cell viability	spectrophotometrical absorbance of the formazan product at 450-500 nm in treated vs. untreated samples	CSV
Sublethal plasma dose	reduction of 50% in viability	-
Antibiotic MIC breakpoints for K. pneumoniae:		
colistin S ≤ 2 mg/L; R > 2 mg/L cefotaxime S ≤ 1 mg/L; R > 2 mg/L ceftazidime S ≤ 1 mg/L; R > 4 mg/L ertapenem S ≤ 0.5 mg/L; R > 0.5 mg/L imipenem S ≤ 1 mg/L; R > 4 mg/L levofloxacin S ≤ 0.5 mg/L; R > 1 mg/L gentamicin S ≤ 2 mg/L; R > 2 mg/L		CSV
Antibiotic MIC breakpoints for E. faecium:		
imipenem S ≤ 0.001 mg/L; R > 4 mg/L levofloxacin S ≤ 4 mg/L; R > 4 mg/L gentamicin S ≤ 128 mg/L; R > 128 mg/L vancomycin S ≤ 4 mg/L; R > 4 mg/L teicoplanin S ≤ 2 mg/L; R > 2 mg/L		CSV

1.3. Morphological and physiological changes of treated calli cultures

Purpose of data collection/generation

Characterization of morphological changes and antioxidant profiles of treated carrot calli could reveal some mechanisms responsible for interactions between RONS produced in plasma and plant cells. Obtained data on the physiological characteristics of plant calli subjected to different APP treatments may also help in defining the optimal conditions for evaluation of biomass production and enhanced formation of somatic embryos.

Format

The parameters which refer to morphology of APPs treated and untreated calli (type of calli, fresh weight change, formation of somatic embryos) will be stored as tables (excel) and pictures (jpeg) with metadata (PDF) containing the treatment conditions, measurements and subsequent data processing. UV-VIS absorbance spectra of antioxidant enzymes together with PAGE and protein immunoblot data will be stored as CSV with complementing metadata (PDF) and processing procedures.

Data utility and reuse

Data may be used in further studies on plasma performance on plant cell/tissue treatments. Potential users are research community related to plasma applications in biology.

The list of specific parameters and their format are given in Table 4.

Table 4. Parameters related to plant calli culture

Daucus carota calli		
Parameter	*Characterization procedure*	*Type of data*
Calli type occurring on root explants	Separation of calli in treated and control samples using binocular regarding their shape and structure	PDF
FW increase/decrease	Calli weight measurement up to 8 weeks after the treatment	CSV
Somatic embryos formation	Determination of treatment efficiency on somatic embryogenesis process calculated as number of embryos formed per gram of embryogenic calli	CSV
Antioxidant enzyme activity	UV-VIS spectroscopy, Native-PAGE	CSV
Detection of specific proteins	Immunoblot analysis using specific antibodies	CSV

2. FAIR data

2.1. Making data findable, including provisions for metadata

Providing the data in the standard formats (CSV, PDF, etc.) along with metadata (PDF) will allow for the most diverse range of possible uses. Naming conventions and keywords where applicable will be according to international recommendations. Metadata will describe the experiments, how the data were collected, where and when.

2.2. Making data openly accessible

Data will be managed by the project coordinator (IPB) and made openly accessible no later than the publication of findings via Zenodo (https://zenodo.org), which is compliant with European rules. Upon establishment of the institutional repository of the Institute of Physics Belgrade, which is planned in near future, the data will be accessible via that service.

Another two approaches to data sharing will be used: 1) online public deposit as supporting information to publications and 2) by the data holder (participant) providing data on request. Copies of data will be provided within 30 days from receipt of the request.

2.3. Making data interoperable

To facilitate the most widespread reuse, measurement data will be provided in a form of excel sheets and/or as comma-separated value (.csv) format. Metadata (as PDF file) will accompany these data to explain what hypotheses the data were originally designed to test, how the data were collected, where and when. Naming conventions will be given and where applicable will be according to international recommendations.

2.4. Increase data re-use (through clarifying licences)

All data will be provided for non-commercial use under General Public License (GPL).

All data will be public.

3. Allocation of resources

Zenodo platform and, upon establishment, of the institutional repository of the Institute of Physics Belgrade, will provide secure, long-term storage, exclusively for research data, so no additional cost for the project will be generated.

4. Data security

IPB will ensure that the data are securely deposited and retained, in an accessible format, for a minimum of two years after project completion. After sending data to repository service, for security purposes, data copies will be kept locally at IPB on an external hard drive. In addition, a copy will be retained with researchers.

5. Ethical aspects

No ethical issues identified.

6. Other issues

No other issues