Atmospheric pressure plasma deposition of PEO-based redox polymers for electrochemical sensing

A Data Management Plan created using DMPonline.be

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Project abstract:

Biosensor and lab-on-chip devices are revolutionizing modern healthcare as they offer great potential for point-of care diagnostics and various bioanalytical applications. A key challenge remains the development of mass manufacturable interface chemistries that allow for stable, reliable, and reproducible immobilization of the bioreceptors onto the sensor substrate. Atmospheric pressure plasma deposition (AP-PD) of poly(ethylene oxide) (PEO) based polymers could offer a low-cost and environmentally friendly solution due to their excellent biocompatibility and antifouling properties. However, conventional AP-PD processes are not compatible with biomolecules due to the harsh direct plasma conditions. Aerosol-assisted AP-PD with an afterglow plasma could limit the degradation but a lack of fundamental insight hampers the development of PEO-based polymers with optimal properties. We therefore propose an investigation of the deposition mechanism and how precursor, co-reagent and AP-PD conditions affect the composition, morphology, and properties of PEO-based polymers. The physical aspects of the process will be investigated with a computational fluid dynamic model to complement experiments. These insights will be used to design AP-PD co-deposition processes that enable the construction of an amperometric biosensor by entrapment of enzymes and redox mediators in PEO layers, hereby demonstrating the potential of AP-PD as an innovative one-step functionalization method.

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Application DMP

Questionnaire

Describe the datatypes (surveys, sequences, manuscripts, objects …) the research will collect and/or generate and /or (re)use. (use up to 700 characters)

Question not answered.

Specify in which way the following provisions are in place in order to preserve the data during and at least 5 years after the end of the research? Motivate your answer. (use up to 700 characters)

Question not answered.

What's the reason why you wish to deviate from the principle of preservation of data and of the minimum preservation term of 5 years? (max. 700 characters)

Question not answered.

Are there issues concerning research data indicated in the ethics questionnaire of this application form? Which specific security measures do those data require? (use up to 700 characters)

Question not answered.

Which other issues related to the data management are relevant to mention? (use up to 700 characters)

Question not answered.

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FWO DMP (Flemish Standard DMP)

1. Research Data Summary

List and describe all datasets or research materials that you plan to generate/collect or reuse during your research project. For each dataset or data type (observational, experimental etc.), provide a short name & description (sufficient for yourself to know what data it is about), indicate whether the data are newly generated/collected or reused, digital or physical, also indicate the type of the data (the kind of content), its technical format (file extension), and an estimate of the upper limit of the volume of the data.

				Only for digital data	Only for digital data	Only for digital data	Only for physical data
Dataset Name	Description	New or reused	Digital or Physical	Digital Data Type	Digital Data format	Digital data volume (MB/GB/TB)	Physical volume
		Please choose from the following options: • Generate new data • Reuse existing data	*Please choose from the following options:* • Digital • Physical	*Please choose from the following options:* • Observational • Experimental • Compiled/aggregated data • Simulation data • Software • Other • NA	*Please choose from the following options:* • .por, .xml, .tab, .cvs,.pdf, .txt, .rtf, .dwg, .gml, … • NA	*Please choose from the following options:* • <100MB • <1GB • <100GB • <1TB • <5TB • <10TB • <50TB • >50TB • NA	
FTIR data	Data from FTIR spectrometer	New	Digital	Experimental	.SPA	<10GB	
XPS data	Data from XPS spectrometer	NEW	Digital	Experimental		<10GB	
Microscopy images	Data from optical microscope	New	Digital	Experimental	.LSM	<10GB	
AFM data	Data from atomic force microscope	New	Digital	Experimental	/	<10GB	
Simulation data	CFD simulation	New	Digital	Simulation data	.h5	<100GB	

If you reuse existing data, please specify the source, preferably by using a persistent identifier (e.g. DOI, Handle, URL etc.) per dataset or data type:

NA

Are there any ethical issues concerning the creation and/or use of the data (e.g. experiments on humans or animals, dual use)? Describe these issues in the comment section. Please refer to specific datasets or data types when appropriate.

- No

Will you process personal data? If so, briefly describe the kind of personal data you will use in the comment section. Please refer to specific datasets or data types when appropriate.

- No

Does your work have potential for commercial valorization (e.g. tech transfer, for example spin-offs, commercial exploitation, …)? If so, please comment per dataset or data type where appropriate.

- Yes

To be determined later in agreement with MPG, as the results might contain sensitive information for MPG.

Do existing 3rd party agreements restrict exploitation or dissemination of the data you (re)use (e.g. Material/Data transfer agreements/ research collaboration agreements)? If so, please explain in the comment section to what data they relate and what restrictions are in place.

- Yes

To be determined later in agreement with MPG, as the results might contain sensitive information for MPG.

Are there any other legal issues, such as intellectual property rights and ownership, to be managed related to the data you (re)use? If so, please explain in the comment section to what data they relate and which restrictions will be asserted.

- Yes

To be determined later in agreement with MPG, as the results might contain sensitive information for MPG.

2. Documentation and Metadata

Clearly describe what approach will be followed to capture the accompanying information necessary to keep data understandable and usable, for yourself and others, now and in the future (e.g., in terms of documentation levels and types required, procedures used, Electronic Lab Notebooks, README.txt files, Codebook.tsv etc. where this information is recorded).

All samples have a unique identiefier consisting of the date + #sample of the day.
Data reflects date on which the deposition experiment was performed. All characterization performed on the samples will use the same sample identifier. All data from 1 specific experiment will be grouped in 1 folder, also containing an excel describing the experimental conditions for every sample.
Metadata will be provided in order to increase the potential for re-use. An adapted Dublin Core Metadata standard will be used and consists of the following metadata elements:

- *Data ID, title, subject, name, creator, owner, related project ID, project summary, data abstract, keywords, type, size, format, source (e.g. ID of measurement device), language, related publications or patents, compliance, security and confidentiality aspects, rights*

The following metadata elements will be added in case the data relates to the results of experiments:

- *Experimental set-up, study design, sampling methodology, variable-level detail, reference to specific model, and all other information necessary for a secondary analyst to use the data accurately and effectively.*

Tabular data will contain SI units, these international Standard Scientific Units of Measurement will be used to denote values.
A folder and filing hierarchy will be set out and documented, schematically represented in Figure 1. Furthermore, an organisational standard workbook file will be used as temporary "data catalog" during the project execution phase, where at the end of the project, easy overview of the created data as well as its potential value for reuse can be easily identified. At the end of the project, the data will be reviewed on reusability, and will be added to the institutional data catalog tool or data catalog excel in the main folder.
Folder set-up and naming will be used to deliver and communicate minimum necessary metadata.

- *Folders will be used to collect metadata with the data, in case the data files cannot be annotated. In this case, a Readme file will be added, in .xls/xlsx format. Where possible, the metadata will be added directly to the data.*
- *Folder structure and naming will be set up according to the structure of the PROJECT/CONSORTIUM, as set out in the project description, by WORK PACKAGES->TASKS->EXPERIMENT->DELIVERABLE, schematically represented in Figure 1.*

File naming conventions will be used to convey minimum necessary metadata as well.

- *ProjectName_SourceInstitution_WorkPackage_DeliverableTitle_DataOfOriginYYYYMMDD_Version*
- *The file names together with the dates of creation allow quick reference to the labnotebook and project description, where the specific experiment(s) are described with more detailed parameters (time, consignee, protocol, samples names, conditions, ...).*
- *All report files will include the document version history, containing version, activity, date and responsible, as added to this document above.*

Will a metadata standard be used to make it easier to find and reuse the data? If so, please specify (where appropriate per dataset or data type) which metadata standard will be used. If not, please specify (where appropriate per dataset or data type) which metadata will be created to make the data easier to find and reuse.

- Yes
- At least the imec metadata standard will be used (see metadata information in the above answer). The following metadata will be kept at minimum, for which a data content catalog will be kept during the project.
    - Data ID, name, creator, owner, related project ID, project summary, data abstract, keywords, type, size, format, source (e.g. ID of measurement device), experimental set-up, related publications or patents, compliance, security and confidentiality aspects.

3. Data storage & back-up during the research project

Where will the data be stored?

Imec Data will be stored on the IMEC SharePoint (teams workspaces), or in specific cases on premise (Isilon). Data may be temporarily stored on researchers' computers or OneDrive's while processing the data. Storing sensitive/confidential (project) information on removable devices such as an external hard disk is not allowed by the imec acceptable use policy because it increases the risk of data loss (either through theft/loss of the disk or in case it breaks down).

How will the data be backed up?

During the project: data on SharePoint will benefit from the following security services:

- *Automatic back-up*
    - *This is managed by Microsoft: The imec sharepoint is hosted on the Microsoft Cloud, which is a high available environment. Information on this environment is never automatically deleted, removal of specific information should be managed by the business.*
    - *If information is removed from this environment, it is moved to a "Recycle Bin". From this Recycle Bin it can still be restored by the user for a period of 93 days (or an admin in case the Recycle Bin was emptied).*
    - *After these 93 days, items are deleted, and Microsoft will keep a backup for 14 additional days. During this period restoration can still be requested through a Microsoft ticket.*
    - *After these 14 additional days, the data is permanently removed.*

Other data on premises (Isilon) have a automatic back-up system. Data is backed up via snapshot technology, where all incremental changes in respect of the previous version are kept online.

Is there currently sufficient storage & backup capacity during the project? If yes, specify concisely.
If no or insufficient storage or backup capacities are available, then explain how this will be taken care of.

- Yes

Office-type documents, smaller amounts of data (< 10 GB), targeted at humans?

- *Yes -> imec Teams/SharePoint*
- *No -> Will the data be written or accessed by a machine without human login, or will the data be accessed outside of imec's internal network, or by external people?*

    - *Yes -> Azure data lake store*
    - *No -> Isilon (on-prem file servers)*

- imec Teams (SharePoint):
    - Only to be used for smaller amounts of files (<10 Gb). Adding more data to a SharePoint is possible, but it is very costly for imec, and SharePoint will start performing badly.
- Azure data lake store: used to store larger amount of data, like "binary" data, "log" data, "measurement" data, ...
    - For larger amounts of files (the capacity is virtually unlimited)
    - Storage exists in many cost-ranges from normally priced cloud storage to very cheap archive storage for data that probably will not be used again.
- Isilon (on-prem file servers): Internal on-prem file shares to store larger amounts of data.
    - For larger amounts of files (but the total space is limited by the hardware that is available at imec, so there is a limit to what is possible)
    - Mainly for data that is actively used, because this storage it too expensive to use as archive storage.

How will you ensure that the data are securely stored and not accessed or modified by unauthorized persons?

During the project: as stated, data on SharePoint will benefit from the following security services:

- *User-authentication, multifactor authentication can be activated*
    - *All logins to imec environments are protected by a strong password (minimal 14 characters) combined with multi factor authentication.*
- *Versioning system*
    - *Versioning is enabled by default on our SharePoint/Teams' environment. This can be modified by workspace owner and is under full responsibility by the business user*
- *System-encryption*
    - *This is managed by Microsoft as outlined in this article: Cloud data security measures in SharePoint & OneDrive - SharePoint in Microsoft 365 | Microsoft Docs*
    - *Making sure that data is shared with the right people is the responsibility by the business user.*
    - *Confidential data will be user encrypted in addition to this:*
        - *When creating documents (.docx, .xlsx, .pptx), the user is forced to assign an information classification label to the document (Public / Restricted / Confidential / Strictly Confidential) based on the sensitivity of the information.*

While this label provides a (visual) marker on the sensitivity level of the information, it will not encrypt the document by default.

What are the expected costs for data storage and backup during the research project? How will these costs be covered?

Storage is available at imec at no added cost to the project. In general can be calculated with 50€ per month for 1terrabyte of data. However, this will not be being charged internally and is included in overhead expenses.

4. Data preservation after the end of the research project

Which data will be retained for at least five years (or longer, in agreement with other retention policies that are applicable) after the end of the project? In case some data cannot be preserved, clearly state the reasons for this (e.g. legal or contractual restrictions, storage/budget issues, institutional policies...).

All data

Where will these data be archived (stored and curated for the long-term)?

After the standard retention period of 5 years, data will be subjected to evaluation. This will include weighing the potential value versus the costs of keeping it available. Decisions will be made by the data owners, in close collaboration with ICT service responsibles for archiving.

What are the expected costs for data preservation during the expected retention period? How will these costs be covered?

In general can be calculated with 50€ per month for 1terrabyte of data. However, this will not be being charged internally and is included in imec overhead expenses.

5. Data sharing and reuse

Will the data (or part of the data) be made available for reuse after/during the project? In the comment section please explain per dataset or data type which data will be made available.

- Yes, in a restricted access repository (after approval, institutional access only, …)

If access is restricted, please specify who will be able to access the data and under what conditions.

o We do not exclude that the proposed work could result in research data with potential for tech transfer and valorization.

o It is expected to obtain data that can potentially be valorised in all workpackages. The data will be kept confidential until 1) a decision will have been made on patenting, and 2) a patent file or publication has been submitted.

Are there any factors that restrict or prevent the sharing of (some of) the data (e.g. as defined in an agreement with a 3rd party, legal restrictions)? Please explain in the comment section per dataset or data type where appropriate.

- Yes, Intellectual Property Rights

All data

Where will the data be made available? If already known, please provide a repository per dataset or data type.

Zenodo.org will be the preferred standard repository for open data, because this platform, part of the OpenAIRE collaboration, provides the minimum and recommended terms required by DataCite's Metadata Schema, including the assignment of an identifier. These services are furthermore free of charge and will be for the foreseeable future.

Software code will be placed in GitHub.com in an open accessible manner to the public.

Physical data and samples will only be stored until the intended analyses are finished and all information is gathered.

When will the data be made available?

Upon publication of research results

Which data usage licenses are you going to provide? If none, please explain why.

- CC-BY-SA: By Attribution, with a Share-Alike clause which means that anyone sharing or modifying the original work must release it under the same license. The material can be freely shared, redistributed, transformed, built upon and adapted for any purpose, including commercial use. Anyone using the material must provide credit to the original authors and indicate clearly any changes that were made. Anyone sharing the work or a derivative of it must do under the same license terms as it was originally shared.

Do you intend to add a PID/DOI/accession number to your dataset(s)? If already available, you have the option to provide it in the comment section.

- Yes

In case of the open publication of data, a PID or DOI will be provided. E.g. Zenodo (repository) creates a Digital Object Identifier (DOI) for each upload.
In case of restricted data that won't be published open, an accession number will be provided by the imec-specific metadata management framework (data catalog).

What are the expected costs for data sharing? How will these costs be covered?

These costs will be covered in project overhead, except in case of circumstances that can be considered out of the ordinary.

6. Responsibilities

Who will manage data documentation and metadata during the research project?

Tijs Dekoster

Who will manage data storage and backup during the research project?

Karolien Jans

Who will manage data preservation and sharing?

Karolien Jans

Who will update and implement this DMP?

Tijs Dekoster