

FWO DMP Template - Flemish Standard Data Management Plan

Project supervisors (from application round 2018 onwards) and fellows (from application round 2020 onwards) will, upon being awarded their project or fellowship, be invited to develop their answers to the data management related questions into a DMP. The FWO expects a **completed DMP no later than 6 months after the official start date** of the project or fellowship. The DMP should not be submitted to FWO but to the research co-ordination office of the host institute; FWO may request the DMP in a random check.

At the end of the project, the **final version of the DMP** has to be added to the final report of the project; this should be submitted to FWO by the supervisor-spokesperson through FWO's e-portal. This DMP may of course have been updated since its first version. The DMP is an element in the final evaluation of the project by the relevant expert panel. Both the DMP submitted within the first 6 months after the start date and the final DMP may use this template.

The DMP template used by the Research Foundation Flanders (FWO) corresponds with the Flemish Standard Data Management Plan. This Flemish Standard DMP was developed by the Flemish Research Data Network (FRDN) Task Force DMP which comprises representatives of all Flemish funders and research institutions. This is a standardized DMP template based on the previous FWO template that contains the core requirements for data management planning. To increase understanding and facilitate completion of the DMP, a standardized **glossary** of definitions and abbreviations is available via the following [link](#).

1. General Project Information

Name Grant Holder & ORCID	Yan Zhao 0000-0003-3660-4669
Contributor name(s) (+ ORCID) & roles	Yan Zhao (0000-0003-3660-4669) postdoc Bart Van der Bruggen (0000-0002-3921-7472) promoter
Project number ¹ & title	12A6823N. Tailoring ion exchange membranes and process for lithium resource recovery from battery waste
Funder(s) GrantID ²	12A6823N
Affiliation(s)	<input checked="" type="checkbox"/> KU Leuven <input type="checkbox"/> Universiteit Antwerpen <input type="checkbox"/> Universiteit Gent <input type="checkbox"/> Universiteit Hasselt <input type="checkbox"/> Vrije Universiteit Brussel <input type="checkbox"/> Other: Provide ROR ³ identifier when possible:
Please provide a short project description	The lithium recovery or extraction from the leach solution of spent lithium-ion batteries (LIBs) is crucial to meet the increasing consumer demand for batteries in appliances and automobiles. However, the extraction is compromised by the presence of competing ions, and the novel design of advanced membrane technologies is one method to address this problem. Electro-driven membranes are a remarkable class of separation materials established as a viable solution for this challenge. Besides, the processes avoid high concentration gradient and osmotic pressure partial to other membranes and have been widely used to separate ions in varying aqueous environments. Although some advanced CEMs with monovalent cation selectivity have been applied in ED, the tailoring of membrane selectivity towards specifically Li ⁺ over competitive co-existing ions is still one of the most challenging topics in the field. Despite the strategic importance of Li ⁺ recycling

¹ "Project number" refers to the institutional project number. This question is optional since not every institution has an internal project number different from the GrantID. Applicants can only provide one project number.

² Funder(s) GrantID refers to the number of the DMP at the funder(s), here one can specify multiple GrantIDs if multiple funding sources were used.

³ Research Organization Registry Community. <https://ror.org/>

from waste streams of the processing of spent LIBs, there is so far no comprehensive study investigates the feasibility using membrane-based separation. In this proposal, a class of novel lithium selective electro-driven membranes based on 2D nanosheets and Kevlar aramid nanofibers (KANF) will be designed with controllable membrane structure, electric properties and high lithium bonding affinity for selective separation of lithium from the leach solution of spent LIBs. Two promising methods are used for the membrane preparation, which are the hybrid 2D materials into KANF casting solution to prepare a mixed matrix membrane 2D#KANF[MM], and the assembly of the 2D materials on a KANF-based membrane surface via a layer-by-layer assembly method, producing a dual layer membrane 2D-KANF[DL]. All the resulting membranes will be characterized by standard physicochemical characterization and the lithium selectivity will be tested in electrodialysis. In this proposal, membrane stack by using the resulting membranes will be designed in ED. Besides, a closed loop separation process is proposed to sustainable recovery of Li⁺ from the leach solution of spent LIBs. with the as-developed membranes and system configurations, filling an important research gap. The specific objectives are to 1) design of highly selective composite membranes towards lithium recovery, 2) conduct surface functionalization for extending membrane reusability, 3) couple optimization experiments with theoretical analysis to reveal separation mechanisms and 4) develop a closed-loop approach to recovery lithium resource from spent LIBs.

2. 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 data⁴.

Dataset Name	Description	New or Reused	Digital or Physical	ONLY FOR DIGITAL DATA	ONLY FOR DIGITAL DATA	ONLY FOR DIGITAL DATA	ONLY FOR PHYSICAL DATA
				Digital Data Type	Digital Data Format	Digital Data Volume (MB, GB, TB)	Physical Volume
<i>Synthesis of</i>	synthesize GO	<input checked="" type="checkbox"/> Generate new	<input checked="" type="checkbox"/> Digital	<input checked="" type="checkbox"/> Observational	<input type="checkbox"/> .por	<input checked="" type="checkbox"/> < 100 MB	The data are stored

⁴ Add rows for each dataset you want to describe.

<i>the 2D nanosheets and porous nanosheets</i>	nanosheets for fabrication of 2D@KANF[MM] membranes. In order to control the size of nanosheets, GO was prepared based on my improved Hummers' method.	data <input checked="" type="checkbox"/> Reuse existing data	<input checked="" type="checkbox"/> Physical	<input type="checkbox"/> Experimental <input type="checkbox"/> Compiled/aggregated data <input type="checkbox"/> Simulation data <input type="checkbox"/> Software <input type="checkbox"/> Other <input type="checkbox"/> NA	<input type="checkbox"/> .xml <input type="checkbox"/> .tab <input type="checkbox"/> .csv <input checked="" type="checkbox"/> .pdf <input type="checkbox"/> .txt <input type="checkbox"/> .rtf <input type="checkbox"/> .dwg <input type="checkbox"/> .tab <input type="checkbox"/> .gml <input type="checkbox"/> other: <input type="checkbox"/> NA	<input type="checkbox"/> < 1 GB <input type="checkbox"/> < 100 GB <input type="checkbox"/> < 1 TB <input type="checkbox"/> < 5 TB <input type="checkbox"/> < 10 TB <input type="checkbox"/> < 50 TB <input type="checkbox"/> > 50 TB <input type="checkbox"/> NA	in my personal PC.
Synthesis of KANF-based gel membrane	The KANFs can be dissolved into DMSO, KOH and H ₂ O mixed solutions and the different blending ratios are explored to form a dense membrane substrate. When the casting membrane solution is obtained, it can be casted on a glass plate by using a casting	<input checked="" type="checkbox"/> Generate new data <input checked="" type="checkbox"/> Reuse existing data	<input checked="" type="checkbox"/> Digital <input checked="" type="checkbox"/> Physical	<input checked="" type="checkbox"/> Observational <input checked="" type="checkbox"/> Experimental <input type="checkbox"/> Compiled/aggregated data <input type="checkbox"/> Simulation data <input type="checkbox"/> Software <input type="checkbox"/> Other <input type="checkbox"/> NA	<input type="checkbox"/> .por <input type="checkbox"/> .xml <input type="checkbox"/> .tab <input checked="" type="checkbox"/> .csv <input type="checkbox"/> .pdf <input type="checkbox"/> .txt <input type="checkbox"/> .rtf <input type="checkbox"/> .dwg <input type="checkbox"/> .tab <input type="checkbox"/> .gml <input type="checkbox"/> other: <input type="checkbox"/> NA	<input type="checkbox"/> < 100 MB <input checked="" type="checkbox"/> < 1 GB <input type="checkbox"/> < 100 GB <input type="checkbox"/> < 1 TB <input type="checkbox"/> < 5 TB <input type="checkbox"/> < 10 TB <input type="checkbox"/> < 50 TB <input type="checkbox"/> > 50 TB <input type="checkbox"/> NA	The data are stored in my personal PC.

	knife.						
Synthesis of ZIFs on membrane surface	Try to synthesis a highly stable ZIFs on membrane surface and then modified with positive charge groups.	<input checked="" type="checkbox"/> Generate new data <input type="checkbox"/> Reuse existing data	<input checked="" type="checkbox"/> Digital <input checked="" type="checkbox"/> Physical	<input checked="" type="checkbox"/> Observational <input checked="" type="checkbox"/> Experimental <input type="checkbox"/> Compiled/aggregated data <input type="checkbox"/> Simulation data <input type="checkbox"/> Software <input type="checkbox"/> Other <input type="checkbox"/> NA	<input type="checkbox"/> .por <input type="checkbox"/> .xml <input type="checkbox"/> .tab <input type="checkbox"/> .csv <input checked="" type="checkbox"/> .pdf <input type="checkbox"/> .txt <input type="checkbox"/> .rtf <input type="checkbox"/> .dwg <input type="checkbox"/> .tab <input type="checkbox"/> .gml <input type="checkbox"/> other: <input type="checkbox"/> NA	<input checked="" type="checkbox"/> < 100 MB <input type="checkbox"/> < 1 GB <input type="checkbox"/> < 100 GB <input type="checkbox"/> < 1 TB <input type="checkbox"/> < 5 TB <input type="checkbox"/> < 10 TB <input type="checkbox"/> < 50 TB <input type="checkbox"/> > 50 TB <input type="checkbox"/> NA	The data are stored in my personal PC.

GUIDANCE:

DATA CAN BE DIGITAL OR PHYSICAL (FOR EXAMPLE BIOBANK, BIOLOGICAL SAMPLES, ...). DATA TYPE: DATA ARE OFTEN GROUPED BY TYPE (OBSERVATIONAL, EXPERIMENTAL ETC.), FORMAT AND/OR COLLECTION/GENERATION METHOD.

EXAMPLES OF DATA TYPES: OBSERVATIONAL (E.G. SURVEY RESULTS, SENSOR READINGS, SENSORY OBSERVATIONS); EXPERIMENTAL (E.G. MICROSCOPY, SPECTROSCOPY, CHROMATOGRAMS, GENE SEQUENCES); COMPILED/AGGREGATED DATA⁵ (E.G. TEXT & DATA MINING, DERIVED VARIABLES, 3D MODELLING); SIMULATION DATA (E.G. CLIMATE MODELS); SOFTWARE, ETC.

EXAMPLES OF DATA FORMATS: TABULAR DATA (.POR, .SPSS, STRUCTURED TEXT OR MARK-UP FILE XML, .TAB, .CSV), TEXTUAL DATA (.RTF, .XML, .TXT), GEOSPATIAL DATA (.DWG, .GML, ..), IMAGE DATA, AUDIO DATA, VIDEO DATA, DOCUMENTATION & COMPUTATIONAL SCRIPT.

DIGITAL DATA VOLUME: PLEASE ESTIMATE THE UPPER LIMIT OF THE VOLUME OF THE DATA PER DATASET OR DATA TYPE.

PHYSICAL VOLUME: PLEASE ESTIMATE THE PHYSICAL VOLUME OF THE RESEARCH MATERIALS (FOR EXAMPLE THE NUMBER OF RELEVANT BIOLOGICAL SAMPLES THAT NEED TO BE STORED AND PRESERVED DURING THE PROJECT AND/OR AFTER).

⁵ These data are generated by combining multiple existing datasets.

<p>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.</p>	<p>Some related operated steps are similar as our previous published papers: DOI: 10.1039/C9TA07416C</p>
<p>Are there any ethical issues concerning the creation and/or use of the data (e.g. experiments on humans or animals, dual use)? If so, please describe these issues further and refer to specific datasets or data types when appropriate.</p>	<p> <input type="checkbox"/> Yes, human subject data <input type="checkbox"/> Yes, animal data <input type="checkbox"/> Yes, dual use <input checked="" type="checkbox"/> No If yes, please describe: </p>
<p>Will you process personal data⁶? If so, briefly describe the kind of personal data you will use. Please refer to specific datasets or data types when appropriate. If available, add the reference to your file in your host institution's privacy register.</p>	<p> <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If yes: <ul style="list-style-type: none"> - Short description of the kind of personal data that will be used: - Privacy Registry Reference: </p>
<p>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.</p>	<p> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No If yes, please comment: The membrane could be developed as common cation exchange membrane based on Kevlar fabric, and it has high potential to be used in industry. </p>

⁶ See Glossary Flemish Standard Data Management Plan

<p>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 to what data they relate and what restrictions are in place.</p>	<p><input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If yes, please explain:</p>
<p>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 to what data they relate and which restrictions will be asserted.</p>	<p><input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If yes, please explain:</p>

3. Documentation and Metadata

<p>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).</p>	<ol style="list-style-type: none"> 1. The data of the synthesis steps will be recorded on a notebooks. 2. The characterizations and testing resulting will be stored in my personal PC with a document.
---	---

<p>Will a metadata standard be used to make it easier to find and reuse the data?</p> <p>If so, please specify which metadata standard will be used. If not, please specify which metadata will be created to make the data easier to find and reuse.</p> <p><i>REPOSITORIES COULD ASK TO DELIVER METADATA IN A CERTAIN FORMAT, WITH SPECIFIED ONTOLOGIES AND VOCABULARIES, I.E. STANDARD LISTS WITH UNIQUE IDENTIFIERS.</i></p>	<p><input checked="" type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>If yes, please specify (where appropriate per dataset or data type) which metadata standard will be used: Different time, I will get different data, so that I can analysis error bar. Therefore, the metadata standard will be used.</p> <p>If no, please specify (where appropriate per dataset or data type) which metadata will be created:</p>
---	--

4. Data Storage & Back-up during the Research Project	
<p>Where will the data be stored?</p>	<p>1. It will be stored on my notebook. 2. It will be stored on my personal PC. 3. It will be shared with my promoter, Professor Bart Van der Bruggen.</p>
<p>How will the data be backed up?</p> <p><i>WHAT STORAGE AND BACKUP PROCEDURES WILL BE IN PLACE TO PREVENT DATA LOSS? DESCRIBE THE LOCATIONS, STORAGE MEDIA AND PROCEDURES THAT WILL BE USED FOR STORING AND BACKING UP DIGITAL AND NON-DIGITAL DATA DURING RESEARCH.⁷</i></p> <p><i>REFER TO INSTITUTION-SPECIFIC POLICIES REGARDING BACKUP PROCEDURES WHEN APPROPRIATE.</i></p>	<p>This data will be stored in diverse ways, including Notebook, my personal PC and online system (such as Teams).</p>

⁷ Source: Ghent University Generic DMP Evaluation Rubric: <https://osf.io/2z5g3/>

<p>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.</p>	<p><input checked="" type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>If yes, please specify concisely: The steps of materials fabrication, materials characterization and resulting materials testing performances will be easily recovered. If no, please specify:</p>
<p>How will you ensure that the data are securely stored and not accessed or modified by unauthorized persons?</p> <p><i>CLEARLY DESCRIBE THE MEASURES (IN TERMS OF PHYSICAL SECURITY, NETWORK SECURITY, AND SECURITY OF COMPUTER SYSTEMS AND FILES) THAT WILL BE TAKEN TO ENSURE THAT STORED AND TRANSFERRED DATA ARE SAFE. ⁷</i></p>	<p>I will only keep these data open with my promoter. Others don't have any permission to check the data.</p>
<p>What are the expected costs for data storage and backup during the research project? How will these costs be covered?</p>	<p>For these data, no cost will be paid for the data storage.</p>

5. 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 the data of this project will be retained for at least five years! After that, it will be decided by Professor Bart Van der Bruggen.
Where will these data be archived (stored and curated for the long-term)?	It can be archived in our group in KU Leuven!
What are the expected costs for data preservation during the expected retention period? How will these costs be covered?	No.

6. Data Sharing and Reuse

<p>Will the data (or part of the data) be made available for reuse after/during the project? Please explain per dataset or data type which data will be made available.</p> <p><i>NOTE THAT 'AVAILABLE' DOES NOT NECESSARILY MEAN THAT THE DATA SET BECOMES OPENLY AVAILABLE, CONDITIONS FOR ACCESS AND USE MAY APPLY. AVAILABILITY IN THIS QUESTION THUS ENTAILS BOTH OPEN & RESTRICTED ACCESS. FOR MORE INFORMATION: HTTPS://WIKI.SURFNET.NL/DISPLAY/STANDARDS/INFO-EU-REPO/#INFOEU-REPO-ACCESSRIGHTS</i></p>	<p> <input type="checkbox"/> Yes, in an Open Access repository <input checked="" type="checkbox"/> Yes, in a restricted access repository (after approval, institutional access only, ...) <input type="checkbox"/> No (closed access) <input type="checkbox"/> Other, please specify: </p>
<p>If access is restricted, please specify who will be able to access the data and under what conditions.</p>	<p>No.</p>
<p>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 per dataset or data type where appropriate.</p>	<p> <input type="checkbox"/> Yes, privacy aspects <input type="checkbox"/> Yes, intellectual property rights <input type="checkbox"/> Yes, ethical aspects <input type="checkbox"/> Yes, aspects of dual use <input type="checkbox"/> Yes, other <input checked="" type="checkbox"/> No </p> <p>If yes, please specify:</p>
<p>Where will the data be made available? If already known, please provide a repository per dataset or data type.</p>	<p>Currently, no.</p>

<p>When will the data be made available?</p> <p><i>THIS COULD BE A SPECIFIC DATE (DD/MM/YYYY) OR AN INDICATION SUCH AS 'UPON PUBLICATION OF RESEARCH RESULTS'.</i></p>	<p>After we publish this work.</p>
<p>Which data usage licenses are you going to provide? If none, please explain why.</p> <p><i>A DATA USAGE LICENSE INDICATES WHETHER THE DATA CAN BE REUSED OR NOT AND UNDER WHAT CONDITIONS. IF NO LICENCE IS GRANTED, THE DATA ARE IN A GREY ZONE AND CANNOT BE LEGALLY REUSED. DO NOTE THAT YOU MAY ONLY RELEASE DATA UNDER A LICENCE CHOSEN BY YOURSELF IF IT DOES NOT ALREADY FALL UNDER ANOTHER LICENCE THAT MIGHT PROHIBIT THAT.</i></p> <p><i>EXAMPLE ANSWER: E.G. "DATA FROM THE PROJECT THAT CAN BE SHARED WILL BE MADE AVAILABLE UNDER A CREATIVE COMMONS ATTRIBUTION LICENSE (CC-BY 4.0), SO THAT USERS HAVE TO GIVE CREDIT TO THE ORIGINAL DATA CREATORS."</i>⁸</p>	<p>All the data, including membrane synthesis, characterization, testing methods, results and analysis. We also will provide the Supporting Information when we publish some papers.</p>
<p>Do you intend to add a PID/DOI/accession number to your dataset(s)? If already available, please provide it here.</p> <p><i>INDICATE WHETHER YOU INTEND TO ADD A PERSISTENT AND UNIQUE IDENTIFIER IN ORDER TO IDENTIFY AND RETRIEVE THE DATA.</i></p>	<p><input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If yes:</p>
<p>What are the expected costs for data sharing? How will these costs be covered?</p>	<p>Currently, no.</p>

⁸ Source: Ghent University Generic DMP Evaluation Rubric: <https://osf.io/2z5g3/>

7. Responsibilities

Who will manage data documentation and metadata during the research project?	My promoter (Professor Bart Van der Bruggen) and I (Dr. Yan Zhao).
Who will manage data storage and backup during the research project?	I (Dr. Yan Zhao).
Who will manage data preservation and sharing?	My promoter (Professor Bart Van der Bruggen) and I (Dr. Yan Zhao).
Who will update and implement this DMP?	I (Dr. Yan Zhao)