Towards mechanistic understanding of biofilms: understanding the transport phenomena, kinetics and rheology of biofilm formation, functioning and morphology.

A Data Management Plan created using DMPonline.be

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Project abstract:

Biofilms are bacterial communities of cells enclosed in a self-produced matrix of extracellular polymeric substances. From an engineering perspective, it is intriguing how the bacterial colonies shape their surroundings to provide protection from external influences (mechanical/chemical stress). On the other hand, the biofilm needs to be structured in such way that bacteria can move during its formation and nutrients can reach the bacteria. In many applications, such as wound healing, food production and industrial fouling, biofilms are undesired. However, biofilms are of growing interest as a positive instrument in biotechnical applications including bioremediation, biofertilization and energy production. The goal of this project is to gain a mechanistic understanding of the internal functioning and morphology of biofilms. To do this, I will investigate the biofilm matrix and its hierarchical porous structure using optical and mechanical techniques. Also the kinetics of biofilm formation, the transport phenomena inside biofilms and bacterial motility in biofilms will be investigated. This mechanistic view of biofilm functioning is novel, and I believe the newly generated insights will contribute to methodologies and principles for design and engineering of biofilms. This will allow optimization of existing applications and will lay the groundwork for invention of new positive applications of biofilms, contributing in the end to the sustainability of our society.

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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
WP1 - Raw confocal microscopy data	Raw data from confocal microscope visualizing the biofilm's 3D structure over time	Generate new data	Digital	Experimental	.lif	<1TB	
WP1 - Image analysis code	Python code to analyze the confocal images and calculate several parameters describing the biofilm structure	Generate new data	Digital	Software	.py	<100MB	
WP1 - Raw data from mass resonator sensor	Raw data gathered from the mass resonator sensors to follow biofilm mass over time	Generate new data	Digital	Experimental	.csv	<1GB	
WP1 - Resonator data processing code	Python code to process the data from the mass resonator sensor	Generate new data	Digital	Software	.py	<100MB	
WP1 - Processed confocal microscopy and mass resonator data	Processed data from confocal microscope using above-mentioned image analysis code. Contains processed images as well as biofilm volume and other parameters over time	Generate new data	Digital	Compiled/processed data	.tiff, .csv, .xlsx	<1TB	
WP2 -Rheometer output data	Raw data from the commercial rheometers giving information on the mechanical properties of the biofilm	Generate new data	Digital	Experimental	.csv	<100GB	
WP2 - Raw data from microrheological experiments	Raw data from the microrheological experiments giving the position and forces impacted on the particles located in the biofilm	Generate new data	Digital	Experimental	.csv	<100GB	
WP2 - Processed microrheological data	Processed data from the microrheological experiments giving the local mechanical properties of the biofilm at different locations	Generate new data	Digital	Compiled/aggregated data	.xlsx	<1GB	
WP2 - Raw microscopy data of bacterial swimming	Raw data gathered from a microscope visualizing the swimming of bacteria in different environments	Generate new data	Digital	Experimental	.tiff	<100GB	
WP2 - Processed bacterial swimming data	Processed data from the bacterial swimming experiments, giving the swimming speed of the bacteria in different environments	Generate new data	Digital	Compiled/aggregated data	.xlsx	<1GB	
WP3 - Raw microscopy data for FRAP measurements	Raw microscopy data of FRAP measurements, giving information on the diffusion of dyes in the biofilm	Generate new data	Digital	Experimental	.tiff	<1TB	
WP3 - Python code for FRAP measurements	Python program used to analyze the FRAP measurements and fit different models to the data in order to extract the diffusion coefficients	Generate new data	Digital	Software	.py	<1GB	
WP3 - Processed FRAP measurement data	Processed data from the FRAP experiments using above-mentioned Python code, giving information on the diffusivity of dyes in the biofilm	Generate new data	Digital	Compiled/aggregated data	.xlsx	<1GB	
WP3 - COMSOL simulation files	Simulated flow profiles and oxygen flux profiles in microfluidic chip containing biofilm	Generate new data	Digital	Simulation data	.csv	<100GB	
WP3 - Oxygen concentration profiles	Measured oxygen concentration profiles in microfluidic chip using PtOEP based sensor	Generate new data	Digital	Experimental	.tiff	<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.

- No

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.

- No

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.

- No

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).

The experimental designs, instrument settings, general and specific observations will be noted in a (digital) lab journal.
For the generated codes, specific readme files will be generated in text form, specifying the usage and detail of the codes. Similarly, for the single simulations, readme files with the specific input parameters will be generated.

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.

- No

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

Where will the data be stored?

Data will be stored on the personal KU Leuven OneDrive, as well as on an external drive dedicated to this project. Large datasets (e.g. confocal microscopy data) will be stored on a NAS located at the Physics department of KU Leuven.

How will the data be backed up?

In addition to the automatic back-up of the data stored on the personal KU Leuven OneDrive, a second back-up will be done on a dedicated external drive, and on a NAS located at the Physics department of KU Leuven.

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

Storage drives have at the moment a capacity of 2 TB. Back-up drives have currently sufficient capacity for this additional data, the secondary backup drives (NAS) are monitored and capacity is adjusted if necessary

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

External data storage as well as NAS data will be encrypted. Data that will be stored on OneDrive will be stored in the university's secure environment for private data.

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

External hard drive has been purchased already, NAS maintenance is carried via general expenses of the SMaRT research group.

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 will be retained for the expected 10 year period after the end of the project, according to the KU Leuven RDM policy.

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

The data will be stored on the university's central servers (with automatic back-up procedures).

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

Expected costs are 2000 EUR, which will be covered from reserve funds.

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 an Open Access repository

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

NA

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.

- No

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

KU Leuven Research Data Repository (RDR) - https://www.kuleuven.be/rdm/en/rdr

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.

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

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.

- No

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

No costs are expected for the use of RDR

6. Responsibilities

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

PhD student working on the project

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

PhD student and promotor working on the project

Who will manage data preservation and sharing?

Promotor

Who will update and implement this DMP?

The promotor bears the end responsibility of updating & implementing this DMP