DMP du projet "Extending the fatigue lifespan of thermoplastic nanocomposites: fundamental insight in particle size and interphase properties effects"

Plan de gestion de données créé à l'aide de DMP OPIDoR, basé sur le modèle "ANR - DMP template (english)" fourni par Agence nationale de la recherche (ANR).

Plan Details

Plan title	DMP du projet "Extending the fatigue lifespan of thermoplastic nanocomposites: fundamental insight in particle size and interphase properties effects"
Version	First version
Fields of science and technology (from OECD classification)	Materials engineering
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Project Details

Project title	Extending the fatigue lifespan of thermoplastic nanocomposites: fundamental insight in particle size and interphase properties effects
Acronym	NANOLIFE
Abstract	High performance thermoplastic composites are a promising option to lighten vehicles in the scope of sustainable development. Focusing specifically on thermoplastic nanocomposites, their fatigue resistance is critical for most applications. Some works report improved fatigue resistance after loading epoxy with nanoparticles, whereas no work exists on the role of particle size and interphase properties on the fatigue life of thermoplastic nanocomposites. The NANOLIFE project aims to understand the molecular mechanisms governing the formation and propagation of cracks in the vicinity of nanoparticles in correlation with their effect on macroscopic fatigue properties. Our holistic approach covers from the particle chemistry to the fatigue characterization and lifespan prediction. As the mechanical response of nanocomposites is highly system-dependent, we chose as a model system silica spheres dispersed in an amorphous glassy matrix. The particles will be grafted with well-defined polymer chains to explore the effects of cohesion between the matrix and the interphase. The interphase thickness and entanglement rate will be screened by i) changing the particle size, grafting density and chain length and ii) implementing dynamic crosslinks in the interphase to trap entangled matrix chains within a dynamic covalent network. The mechanical tests will enable to link the interphase properties to failure modes with a multiscale approach. Digital image correlation and infrared thermography monitoring during crack propagation fatigue tests will be applied to access local strains near the crack tip and crack propagation rate. Damage mechanisms will be identified from thermographic data recorded during tensile-tensile fatigue to predict lifespan. In parallel to the experimental work, numerical approaches will bring understanding in chain conformation, dynamics and interfacial adhesion with grafted nanoparticles as well as initiation of the damage during fatigue cycles.
Funding	• French National Research Agency : ANR-22-CE06-0028
Start date	2023-01-01
End date	2026-12-31
Partners	• LGP - Laboratoire Génie de Production 199513626M • CP2M - Catalyse, Polymérisation, Procédés et Matériaux 202123703C • CEMEF - Centre de Mise en Forme des Matériaux 199719336K • LMPS - Laboratoire de Mécanique Paris-Saclay 202224176M • Roberval - Unité de recherche en mécanique acoustique et matériaux 201220262B

Research outputs :

1. Default research output

Contributors

Name	Affiliation	Roles
CHABERT France - https://orcid.org/0000-0001-6309-4372	Ecole Nationale Ingénieurs Tarbes - 199513626M	• Project coordinator
YAHIAOUI Malik - https://orcid.org/0000-0002-4798-5439		• DMP manager • Data contact

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1. Data description and collection or re-use of existing data

1a. How will new data be collected or produced and/or how will existing data be re-used?

The data will be collected by all project members including managers, students, PhD students, postdocs, engineers and technicians:

1. Data collection: The materials analysis and the modeling data will be directly collected with specific softwares and the data will be exported in open formats. All data will be referenced in a database (e.g., in an .xls file).
2. Metadata: All datasets will be stored and classified using a clear and unique name. The experimental campaigns conditions will be recorded in standard laboratory notebooks with a unique serial number.
3. No anterior data is expected to be used.

1b. What data (for example the kind, formats, and volumes), will be collected or produced?

Various types of data will be collected or produced during the NANOLIFE project, including:

1. Experimental data: This can include measurements of physical, chemical, or mechanical properties of materials, such as stress-strain curves, density, and nano-particles content. The format of experimental data will include graphs, tables, and raw numerical values.
2. Data regarding the processing/manufacturing of PMMA nanocomposites including textual data collected in laboratory notebooks and databases (e.g. .txt, .xls and pdf formats).
3. Microscopy data: This can include images or spectra obtained using different microscopy techniques, such as scanning electron microscopy (SEM), transmission electron microscopy (TEM), and atomic force microscopy (AFM). The format of microscopy data can include images, 2D or 3D models, and numerical data extracted from the images.
4. Computational data: This can include data generated using computational simulations or modeling of material properties, such as finite element analysis (FEA). The format of computational data will include input/output files, graphs, and numerical data.
5. Chemical composition data: This can include data on the chemical composition of materials using techniques like FTIR, XRD and EDX. The format of chemical composition data can include tables, graphs, and numerical data.
6. Mechanical data: This will include data on the performance of materials such as fracture toughness, hardness and fatigue tests results. The format of performance data can vary depending on the specific application and can include tables, graphs, and numerical data.
7. Communication: This will include the presentations and reports (.ppt or .pdf) performed all along the project.

The volume of data collected or produced during the project in the field of materials science can vary depending on the number of measurements or simulations performed. The NANOLIFE project is expected to produce a large amounts of data.

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2. Documentation and data quality

2a. What metadata and documentation (for example the methodology of data collection and way of organising data) will accompany the data?

Metadata and documentation that will accompany the data in the NANOLIFE project will include:

1. Data collection methodology: A detailed description of the procedures and instruments used for data collection, including information about the sample preparation, measurement conditions, and calibration procedures.
2. Instrument parameters: A record of the instrument settings used during data collection, such as the microscope magnification, camera settings, or laser power.
3. Data format and organization: A clear and consistent format for data storage and organization, including file naming conventions, folder structure, and file types.
4. Data processing steps: A description of the data processing steps used to obtain the final results, including any software tools used and the parameters used for data filtering, analysis, and interpretation.
5. Quality control procedures: A description of the quality control procedures used to ensure the accuracy and reliability of the data, including any checks on instrument performance, sample preparation, or data processing.
6. Metadata standards: Adherence to established metadata standards, such as the Recherche Data Gouv (RDG) metadata schema, which provides guidelines for metadata elements relevant to materials science research.

2b. What data quality control measures will be used?

The NANOLIFE project will include the following data quality control measures:

1. Instrument calibration: Regular calibration of instruments used in data collection to ensure their accuracy and precision.
2. Data validation: Checking the data for completeness, accuracy, and consistency, including identifying and correcting any errors or outliers.
3. Replicate measurements: Collecting multiple measurements of the same sample to assess the reproducibility of the data.
4. Blind measurements: Collecting measurements without prior knowledge of the sample identity or expected results to eliminate bias in the data.
5. Statistical analysis: Using statistical analysis tools to identify trends, correlations, and patterns in the data, and to assess the variability and uncertainty of the results.
6. Inter-laboratory comparisons: Participating in inter-laboratory comparisons to compare the results with those obtained by other laboratories and to identify any discrepancies or inconsistencies.
7. Quality control samples: Including quality control samples in the data collection process, such as reference materials or blanks, to assess the accuracy and precision of the measurements.

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3. Storage and backup during the research process

3a. How will data and metadata be stored and backed up during the research?

The NANOLIFE project will store and back up data and metadata using:

1. Local storage: Data and metadata will be stored on a local hard drive or a network drive accessible to the research team. Regular backups of the data and metadata will be created and stored on external hard drives, which will be kept in a secure location in the laboratories.
2. Cloud storage: Data and metadata will be stored on institutional cloud-based platforms. Cloud storage provides the advantage of easy accessibility and data sharing among researchers. Additionally, cloud-based platforms often have built-in backup and data recovery options that help protect against data loss.
3. Institutional Git repositories: Institutional Git repositories provide secure and long-term storage options for research data and metadata with a version control system (VCS).
4. Recherche Data Gouv (RDG): The RDG platform is the federated national research data platform serving the French scientific community. This platform offers a multidisciplinary data repository and a catalog for reporting data hosted in other repositories. The repository can be associated to a DOI. The RGD platform also provide Metadata management (Data Documentation Initiative, DDI) and a version control system (VCS).

The project members will also regularly verify the integrity and completeness of the backed-up data and metadata to ensure that they can be restored correctly in case of a data loss event.

3b. How will data security and protection of sensitive data be taken care during the research

Here are some steps that will be taken to consider data protection and manage the associated risks:

1. Identify the sensitive data: Identify the sensitive data and document its nature, content, and location.
2. Risk assessment: Conduct a risk assessment to identify potential threats, vulnerabilities, and risks associated with the sensitive data. Some of the main risks include data breaches, unauthorized access, theft, loss, or destruction of data.
3. Secure storage: Store sensitive data in a secure location, such as a password-protected server or encrypted storage. Access to this data should be limited to authorized personnel only.
4. Data anonymization: Anonymizing the sensitive data by removing identifying information.
5. Monitoring: All partners will monitor access to sensitive data, including who has accessed it and when to help detect any unauthorized access or data breaches.
6. Data sharing agreements: All partners will have access on shared data in Cloud Storage and specific repositories.

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4. Legal and ethical requirements, code of conduct

4a. If personal data are processed, how will compliance with legislation on personal data and on security be ensured?

No collection of personnal data will be done in the NANOLIFE project.

4b. How will other legal issues, such as intellectual property rights and ownership, be managed? What legislation is applicable?

Each participant will be associated to publications according to their respective contributions.

4c. What ethical issues and codes of conduct are there, and how will they be taken into account?

Each participant involved in the NANOLIFE project will agree to respect the rules of research ethics.

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5. Data sharing and long-term preservation

5a. How and when will data be shared? Are there possible restrictions to data sharing or embargo reasons?

Before publication, data will be shared among participants using the Cloud storage and repositories. Data sharing will depending on data sensitivity. Concerning published data, to promote data accessibility, open access publications will be favored whenever possible and all data will be posted in HAL public repository. Long-term data sharing will be done in compliance with journal or patent agency embargo rules where applicable.

5b. How will data for preservation be selected, and where data will be preserved long-term (for example a data

repository or archive)?

All data concerning the NANOLIFE project will be stored permanently on institutional servers. Open data and dataset will be made available for an extended long time period using HAL and RDG platforms.

5c. What methods or software tools are needed to access and use data?

Standard softwares will be favored to publish and to open data files (e.g., .txt, . docx, .xlsx, .pptx, .pdf). Some proprietary softwares will be used such as Matlab for data processing. However, data sets will be made accessible in open format as .txt, .CSV, etc.

5d. How will the application of a unique and persistent identifier (such as a Digital Object Identifier (DOI)) to each data set be ensured?

The application of a DOI to scientific publication and datasets will be insured by journal editors and by RDG platform.

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6. Data management responsibilities and resources

6a. Who (for example role, position, and institution) will be responsible for data management (i.e. the data steward)?

1. Data stewardship: Data entry, production of metadata, data quality monitoring as well as data storage and sharing will be insured by all participants of the NANOLIFE project.
2. Data coordination: The data exchange terms will be regularly set during the project and in particular after each meeting. Each partners leader will be in charge of this coordination and will participate to the DMP.
3. DMP manager:
4. DMP updates: The DMP will be updated after each project meeting.

6b. What resources (for example financial and time) will be dedicated to data management and ensuring that data will be FAIR (Findable, Accessible, Interoperable, Re-usable)?

The project partners will insured that data generated by the NANOLIFE project are FAIR as much as possible.