Holistic, reliable and practical Characterization Framework for Graphene-Family Materials, a correlated approach including Imaging-based techniques

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1. Introduction

ACCORDs is an Horizon Europe project working in the development of an imaging-based characterization framework (ACCORDs framework) for the holistic correlative assessment of Graphene Family Materials (GFMs) as a representative of 2D nanomaterials (NMs) to assess and predict 2D NMs health and environmental risks.

The ACCORDs framework will operationalise safe and sustainable by design (SSbD) strategies proposed in past or ongoing H2020 projects or within OECD by **correlating low-, medium-, and high-resolution physico-chemical-biological imaging-based methods with non-imaging methods in a tiered approach**. ACCORDs will deliver the ACCORDs framework and user guidance, new imaging-based characterisation methods, reference in vitro tests, new reference 2D NMs for different matrices, a new minimum information reporting guideline for FAIR data sharing and reuse of images as well as an atlas with reference images for diagnostics of compromised safety of GFMs / GFM products. The new guidelines and standard proposals will be submitted to standardisation bodies to allow creation of regulatory ready products. The novelty of ACCORDs is in **translating the principles of medical imaging-based diagnostics to 2D material hazard diagnostics**. ACCORDs will accelerate industrial sectors in the area of aviation, marine construction, drone production, flexible electronics, photovoltaics, photocatalytics and print inks-based sensors. The value ACCORDs proposes to the graphene industry are practical, easy, imaging-based tools for GFM quality monitoring next to the production line with a possibility to be correlated with advanced high-resolution imaging characterization methods in case hazard i.e. deviation from controls

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(benchmark values) are diagnosed. The ACCORDs framework and tools will contribute to the European Green Deal by addressing the topic: “Graphene: Europe in the lead” and to a new European strategy on standardization, released on 2nd February, 2022.

2. Objectives

- To develop purpose-oriented correlative approaches for the characterization and quantification of 2D nanomaterials as produced and in complex matrices and determination of their transformations in such environments.
- To increase the availability of validated protocols to advance both nanosafety studies and material characterisation and deliver improved data reporting guidelines.
- To ensure appropriate, realistic in vitro models to address current gaps in nanotoxicology.
- To deliver reliable data to support computational modelling and the development of grouping and read-across methods.
- Worldwide accepted risk assessment tools for establishing a robust supply chain for GFMs.

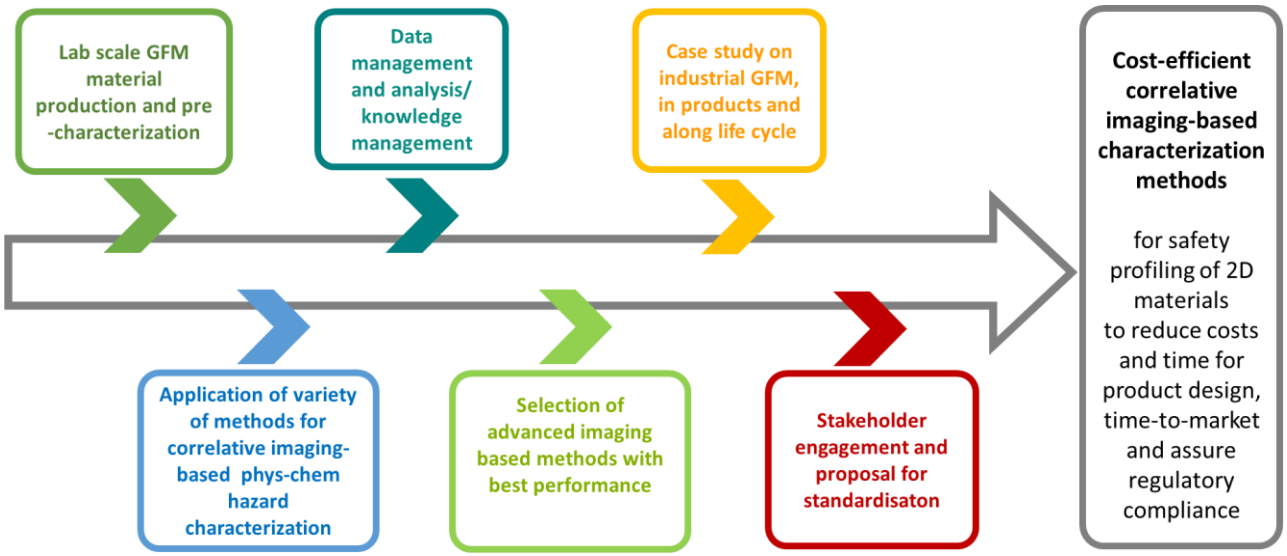

Figure 1 ACCORDS Workflow

3. Ongoing activities

- Graphene Oxide Materials produced, characterised and distributed to the consortium.
- Wide array of Physico-Chemical and Biological-Hazard characterisation techniques are being performed.
- Omero installed and discussions on image uploading.
- Engagement with International Standardisation Organisations & Identification of gaps in available literature.
- Design & Execution of a Dissemination Plan and identification of exploitable results.

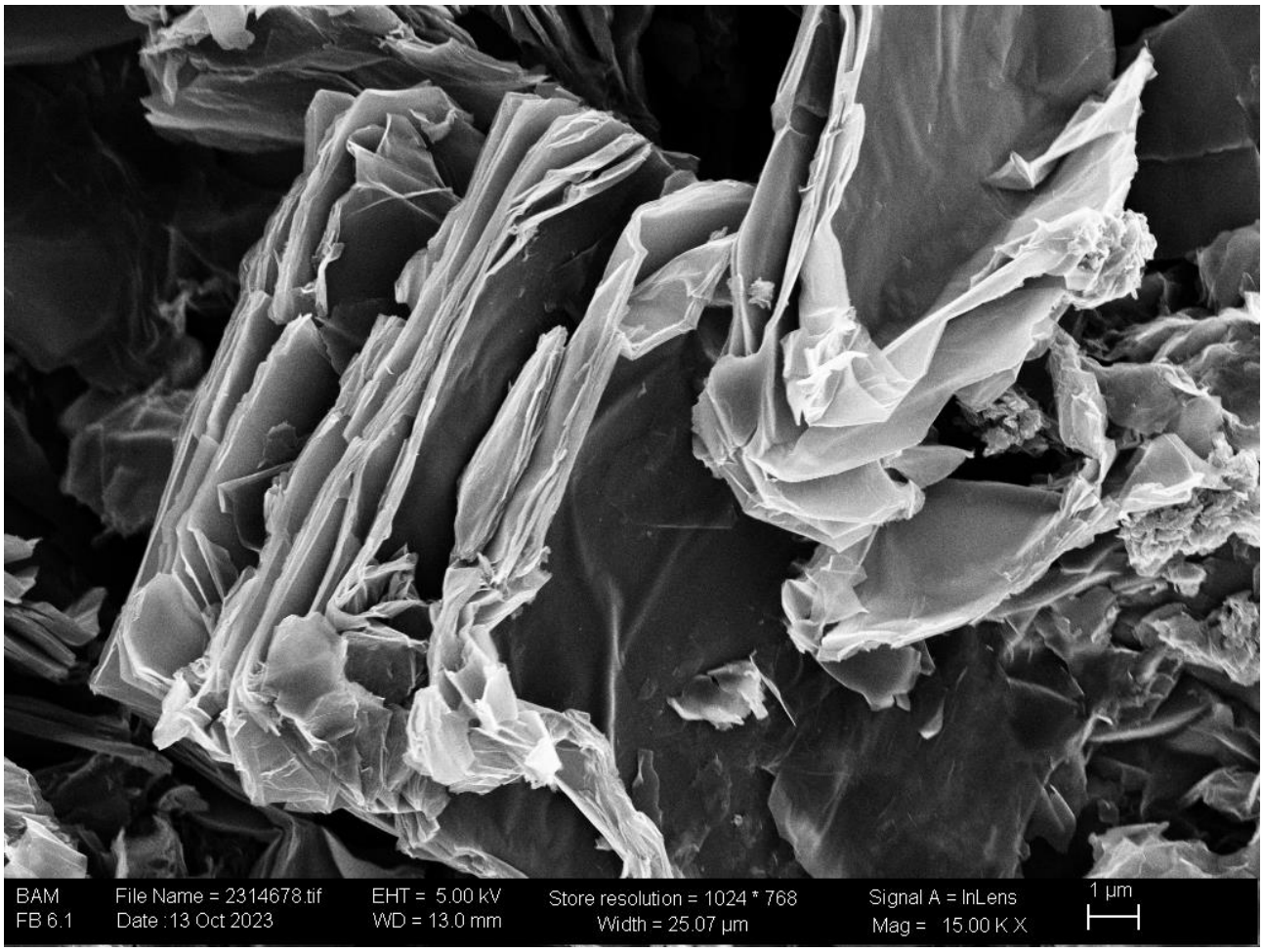

Figure 2: GFM Image from SEM technique at BAM

4. Expected Outcomes

- ACCORDs will deliver a new imaging-based correlative characterisation framework including **new regulatory compliant characterization methods** (5-10 **new** methods).
- Up to 10 **new** standard operating procedures (SOPs), new TMDFs along with TDRFs as a basis for data/images FAIRification, and decision-making workflows, computational modelling, and grouping and read-across.
- New imaging-based protocols (up to 5 **new** protocols are expected) will
- be integrated with already available ones to assure a correlative and tiered approach to advance nanosafety testing.
- Artificial Intelligence (AI) and machine learning-based analysis of material properties will provide new models supporting product design and decision-making.
- Up to 5 proposals for new technical documents for standards and guidelines to international standardisation bodies.
- A reliable and practical imaging-based characterization **framework** for the holistic imaging based correlative characterisation of 2D to allow creation of **regulatory ready products**.
- A user guide (for 2D nanomaterial producers, downstream users, and consultants).
- A catalogue (Atlas) of reference physico-chemical and biological /safety characteristics for 2D nanomaterial for practical **safety diagnostics to simplify**

monitoring of 2D nanomaterials along the value chain (quality and safety control) in analogy with medical imaging-based diagnostics.

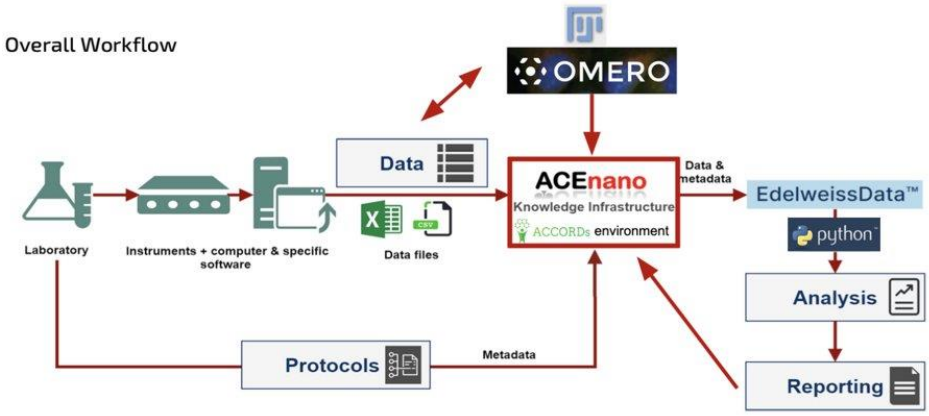

Figure 3: Digital workflow for the development of a knowledge infrastructure

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