

**A changing regulatory landscape
and language for the nanoscale**
April 2021

NIA

Nanotechnology
Industries Association

A changing regulatory landscape and language for the nanoscale

The European Commission published a recommendation on a definition for nanomaterials in 2011 (currently under review). However, the term nanomaterial is very broad, and differences in nanomaterial properties exist in relation not only to their corresponding bulk counterpart, but also to nanoforms of the same substance. NIA welcomes the introduction of the term “nanoform” in Regulation (EU) 2020/878, which should introduce more transparency regarding the risk profiles of substances at the nanoscale. The transition to the word “nanoform” is expected to require some time, and the justification of sets of nanoforms under the REACH framework remains a challenging exercise. On this front, EU-funded projects grouped under the NanoSafety Cluster (NSC) are producing data to contribute to the identification of boundaries between nanoforms and sets of nanoforms.

The current regulatory landscape

Many well-established European regulations are intrinsically dynamic, allowing shifts in their frameworks to account for scientific advances. The REACH Annex amendments (Regulation (EC) 2018/1881) that came into force on January 1st 2020 introduced **the next generation of regulatory and scientific developments for substances engineered at the nanoscale**[1]. Whilst originating within the EU, this is also expected to influence global approaches to hazard and risk assessment, and to change how nanomaterials are developed and reviewed for development into diverse products.

Any chemical, and now nanoform, that is produced, imported and/or used in the EU above 1 tonne/year must be registered under the REACH Regulation. The 2020 REACH amendment states that this tonnage is applicable per registrant per substance. Moreover, it is the cumulative tonnage of all physical forms (e.g. nanoform, bulk, massive) that drives the regulatory requirements for a registrant, not the bulk (>100 nm) and nanoform quantities separately: the cumulated quantity of the substance, resulting from the quantity of the bulk and nanoforms, determines the applicable information requirements as outlined in Annexes VII to X of REACH. These requirements include certain physicochemical data, toxicological information, and ecotoxicological information; in addition, the tonnage increase triggers increasing information requirements.

Nanoforms must now be submitted in separate dossiers as single nanoforms. The submission of more than one nanoform in a single dossier is only possible for clearly defined and justified “sets” of nanoforms. Robust supporting data must demonstrate that those nanoforms have similar enough exposure, hazard, and risk profiles to justify grouping them in the same set. The aim of this substantial regulatory development is to bring **a greater level of granularity and transparency to nanoscale substances entering the market**,

while also **giving industry a clearer indication of the regulatory requirements for nanoforms**.

Substances including high profile candidates for restriction, such as carbon nanotubes (CNTs), will now be clearly differentiated for hazard (identification and labelling) through sets of nanoforms (e.g. flexible vs rigid, coated vs non coated, etc.), clearly showing any divergence in risk and hazard on a per nanoform basis. Transparency will be also enhanced by the amendment to REACH Annex II, applying as of January 1st, 2021, with a transitional period until 31 December 2022 (Commission Regulation (EU) 2020/878): the amendment relates to the **inclusion of the word “nanoform” in the safety data sheets**, if relevant, together with particles characteristics of the nanoform, dissolution rate, or dispersion characteristics in different media[2].

The regulatory framework for nanoforms allows safe manufacture and use by indicating when Risk Management Measures (RMMs) and Operational Conditions (OCs) should be in place; appropriate hazard and risk communication; as well as, once knowledge on the properties of the different nanoforms has been gathered, the identification of the safest and most efficacious form of a substance to be used within products. This ultimately feeds into a **standard understandable format which increases transparency on specific nanoforms, allowing increased customer and consumer trust**. It also allows a focus on how to ensure that nanoforms can be identified and managed throughout their lifecycle, always having in mind the cost/benefit and performance analysis for the process to be viable[3]. This is critical for **the role of nanoforms within the EU Green Deal, with its increasing focus on safe by design and circularity**[4]. One such case study was performed by the OECD[5], exploring the introduction of nanotechnology in the tyre industry as an alternative to current practices regarding safety and sustainability.

The next generation of governance for the nanoscale – enter the nanoform

In response to the significant regulatory and industrial changes in the landscape for substances engineered at the nanoscale, **the use of language needs to also change**. The hundreds of millions of euros invested over two EU Framework Programmes between 2007 and 2020, and the knowledge thus generated, have ensured that all nanoscale stakeholders – whether industry, policy or civil society – should have the appropriate understanding of the diversity of chemistries and forms of nanoscale materials: when it comes to managing and regulating substances at the nanoscale, **the time has come for the transition to a focus on nanoforms and sets of nanoforms**.

Commission Recommendation of October 2011 on the definition of nanomaterial (2011/696/EU)

A natural, incidental or manufactured material containing particles, in an unbound state or as an aggregate or as an agglomerate and where, for 50 % or more of the particles in the number size distribution, one or more external dimensions is in the size range 1 nm - 100 nm.

In specific cases and where warranted by concerns for the environment, health, safety or competitiveness the number size distribution threshold of 50 % may be replaced by a threshold between 1 and 50 %.

Commission Regulation (EU) 2018/1881

A nanoform is a form of a natural or manufactured substance containing particles, in an unbound state or as an aggregate or as an agglomerate and where, for 50 % or more of the particles in the number size distribution, one or more external dimensions is in the size range 1 nm-100 nm, including also by derogation fullerenes, graphene flakes and single wall carbon nanotubes with one or more external dimensions below 1 nm.

Definitions of nanomaterials and nanoforms according to the EU Commission

This evolution in the regulatory framework brings the need for new terminology around nanoscale substances. Within the EU, regulators and industry have already started adopting the language of nanoforms; all other stakeholders will need to follow, in order to adequately reflect the landscape in which nanoscale materials are developed and brought to the market. It is also assumed that, even after Brexit, the situation will be similar in the UK, with nanoforms expected to be adopted into the UK REACH. Other countries also follow EU developments, and it is possible that they may look into adopting some aspects of the nanoforms paradigm into their own regulations in the future.



This is important for a critical reason. The driver for the changes to the REACH Regulation were the concerns over the complexity of establishing robust hazard profiles for chemicals at the nanoscale, including owing to the diversity of nanoforms of a single substance. Particle characteristics and behaviour differ significantly based on factors such as particle size, surface area, chemical composition, surface functionalisation, charge, morphology, and porosity. This means that uniform hazard assessments cannot always be generated on the sole basis of the chemical element and the particles size. One such example is that of nanosize silver or zinc, where different sizes are associated to different levels of toxicity[6]: if all silver nanoforms were treated in the same way, their individual risks/hazards could be over or understated. Worse, this key enabling technology as a whole may be labelled as not fit for purpose on the basis of the assessment of only a sub-group of its class, leading to a loss of trust from consumers or even, in the worst-case scenario, complete removal from the market. Within the broader media and some campaign groups, this issue has translated into a blanket assumption of higher risk for nanoscale materials, regardless of the specific substance or its uses. This in turn has generated frustration to those communities developing novel materials, where a significant advance in product capability is weighed down by the immediate association with a negative perception.

The 2020 REACH amendment now enables the presentation and justification of distinct nanoforms, and sets of nanoforms, with well defined-hazard profiles: this means that **the term “nanomaterials” should no longer be used as a blanket or “catch-all” word when referring to the hazard and risk profiles of substances at the nanoscale**.

While ECHA has published guidance documents providing advice on how to build and justify sets of nanoforms[7], this still remains a challenging exercise: however, some tools[8] are already available to help registrants comply with REACH information requirements and sets of nanoform justifications.

“Data! Data! Data! I can’t make bricks without clay”

The EU has led the way in the nanosafety research underpinning the changes to the REACH Regulation. Major projects funded throughout the FP7 and Horizon 2020 programmes created the NanoSafety Cluster (NSC)^{viii}, with projects NANOREG, NanoDefine, and Prosafe leading early global efforts, and the next generation of projects bringing the earlier learnings into more industrially relevant applications and methodologies^[9]. Projects such as GRACIOUS and NanoCommons focus on the “enabling” phase of substance characterisation, testing, grouping and read-across; while external initiatives, such as the ECETOC^[10] NanoApp support the creation and justification of nanoform sets within the ECHA guidelines^[11]. Finally, a set of new-generation projects (Gov4nano, RiskGone, and Nanorigo) look further ahead into the governance of nanotechnologies, while also exploring frameworks to assist the future implementation of Safe by Design approaches into R&D practices.



Over a decade, the NSC work has created the current data and methods where sets of nanoforms are starting to define future nano development in industry. At the 2020 NIA Symposium, the majority of surveyed participants indicated that they use data from EU projects in their material development. This data helps the industrial community to develop nanoform datasets. Yet, the majority of projects focused on a narrow set of nanoforms (often those included in the OECD sponsorship programme and the EU Joint Research Centre repository of test materials), or on the generation of data not usable under the current regulatory frameworks or for which basic data to demonstrate the studies reliability and relevance is simply missing. Although the data can be used for read-across purposes, these issues limit the broad impact of the projects results beyond proof-of-concept (It should be brought into context that data was gained on these projects in order to begin to understand and define some of the basic concepts and relationships between nanoform physical chemical characteristics and their toxicology and fate, thus the focus was not misplaced).

The nanomaterial is dead... long live the nanoform

We have entered a **transition phase**: on one hand, the language of nanoforms becomes more widely used, and examples of nanoform sets can be increasingly demonstrated in the public domain; on the other hand, there is a significant learning curve for both industry and ECHA, with guidance and industrially accessible methodologies lagging behind many of the headline REACH requirements for nanoform sets. The scientific community may still refer to the term nanomaterials (e.g. 20 nm TiO₂) as a way to gather information to help address the boundaries of nanoforms.

However, **all stakeholders should be reassessing the language they use where relevant, particularly when discussing hazard**, and where non-specific terminology may be misleading and result in confusion and mistrust in the safety of substances at the nanoscale.

We call for the use of the term “nanoform” as a way of referring to specific nanomaterials within a given class. We believe that the term “nanomaterial”, when used for hazard profile description, is too generic and ambiguous for regulatory purposes, and may undermine the long-term development of the nanotechnology industry. This change in concept and terminology will lead to **greater confidence in nanoforms** and support a **wider acceptance of this key enabling technology**, leading not only to the further development of advanced technologies but also to the growth of the nanoform market in the EU.

As far as chemicals are concerned, nanoforms and sets of nanoforms are the future of industrial development at the nanoscale: as the regulatory framework evolves to take this into account, we call for the language to also evolve to bring greater clarity in this space.

About NIA

The NIA is the industry association for the nanotechnology sector and supports Members for their responsible and successful innovation. It is part of the NIA mission to help Members develop innovations that improve the lives of consumers, preserve the environment and advance our world. NIA supports nanotechnology industries through providing clear industry perspectives and positions on key issues for sectors working with nanotechnology and nanomaterials Industries Association (NIA) is the cross-sectoral, responsible voice for nanotechnology value chains and the global commercial eco-system. NIA supports innovation and commercialisation of next generation of nanotechnologies and promotes their safe and reliable advancement. Since its foundation in 2005, NIA has served Members from across the nanotechnology spectrum.

To learn more: www.nanotechia.org

1 EC amended REACH regulation to address nanoforms (2018/1881) <https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1583937204435&uri=CELEX:32018R1881>

2 Commission Regulation (EU) 2020/878 amending Annex II of the REACH Regulation

3 Kraegeloh et al., *Nanomaterials*, April 2018, 14;8(4):239

4 https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

5 OECD, *Nanotechnology and Tyres: Greening Industry and Transport*, July 2014

6 Park et al., *Biomaterials*, December 2011, 32(36):9810-7

7 ECHA, Appendix for nanoforms to the Guidance on Registration and Substance Identification, 2019

8 <https://www.nanosafetycluster.eu/>

9 <https://www.nanosafetycluster.eu/nsc-overview/nsc-structure/steering-group/>

10 <http://www.ecetoc.org/>

11 ECHA, *How to prepare registration dossiers that cover nanoforms*. Best Practices, 2017, https://enuveprod-universitatpolit.netdna-ssl.com/php_previsionintegral/sites/default/files/noticia/38091/field_adjuntos/howtoregisternanoen.pdf



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