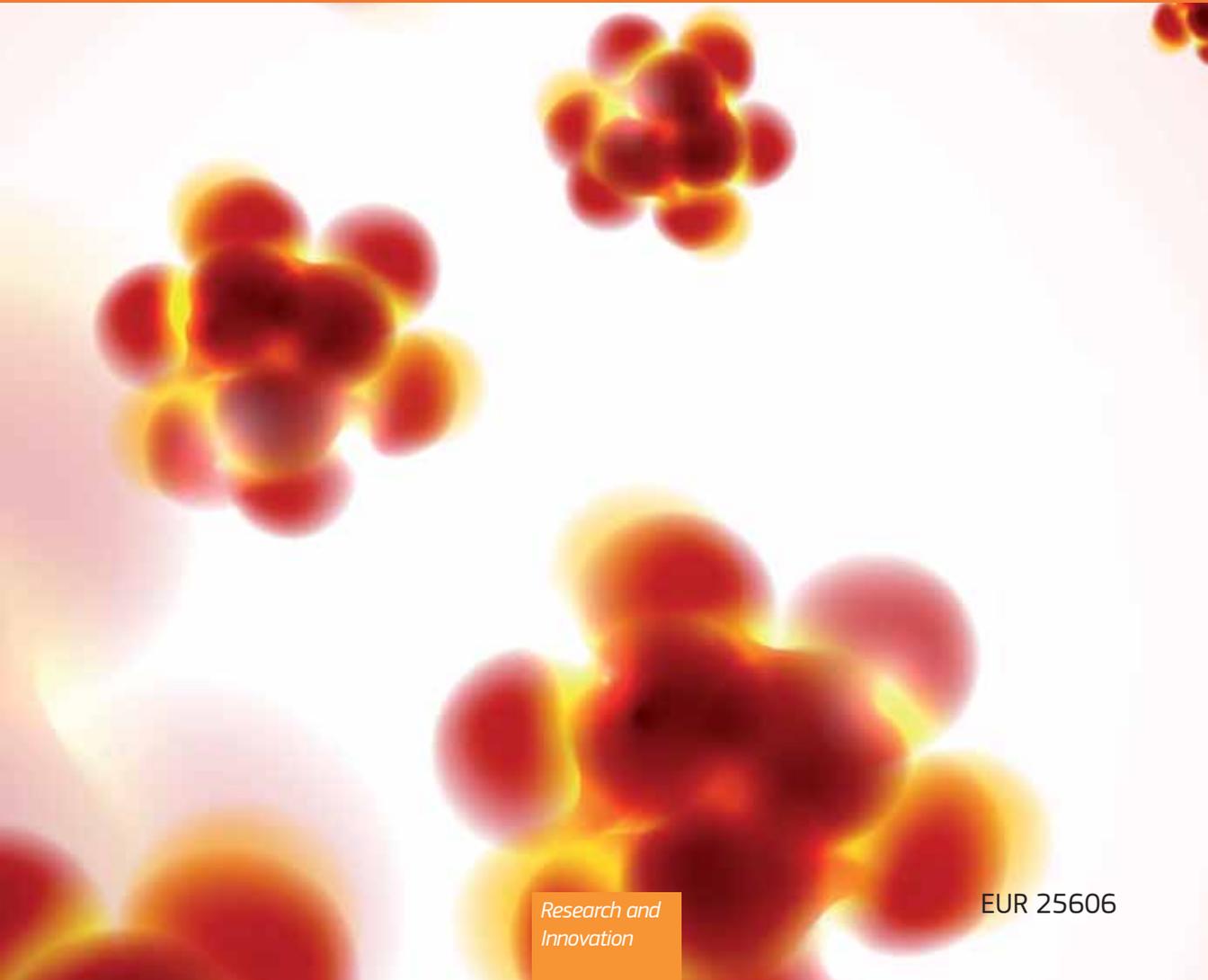




European Research and Innovation in Materials Science and Engineering: What to change in the future?

Report from the Materials Summit in Brussels,
10 September 2012



EUROPEAN COMMISSION

Directorate-General for Research and Innovation
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EUROPEAN COMMISSION

**EUROPEAN RESEARCH AND INNOVATION
IN MATERIALS SCIENCE AND ENGINEERING:
What to change in the future?**

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Background

Seventy per cent of all technical innovations are directly or indirectly linked to materials¹; this percentage has been increasing since 1970 and is forecast to continue increasing steadily until 2030. European industry cannot remain competitive and be really sustainable without a continuous innovation in materials. The recent co-signature of the Aarhus Declaration by representatives of Industry and the Materials Research communities captures this relevance².

Advanced Materials have been identified by the European Commission as one of the five Key Enabling Technologies (KETs)³. A High Level Group (HLG) on KETs was established⁴ by the European Commission, and suggested a long term strategy⁵ for a more effective industrial deployment of key enabling technologies in the EU.

In October 2010 the first Materials Summit was organised by the EC, which came to the conclusion that materials development can most effectively be performed in a hybrid matrix working model, with applications-driven research, technological development and innovation (R&D&I) along the

vertical columns (“from ideas to applications”) and horizontal cross-cutting multi-application multi-disciplinary research activities. In order to increase the chances that materials R&D results find their way into applications, and to expedite this process with economic benefits for the European industrial economy, a 3-stage innovation trajectory was suggested as a model. The first stage – basic research – is provided by the universities, with support from the European Research Council (ERC) and the Future and Emerging Technologies (FET) programme. In the second stage the R&D results are transformed into materials technologies applicable in an industrial environment; this activity could be best carried out in dedicated multi-disciplinary infrastructures capable of exploring different recipes in parallel and performing a first scale-up. The third stage, turning materials technology into real applications, is done within the relevant industry. The importance of the involvement of the whole value chain was highlighted.

With regard to grouping materials in the context of structuring research funding (potential criteria: predefined expected performance, classes of materials, materials for specific applications, industries or challenges, others), “functionality” was recognised as the most meaningful grouping criterion.

An important observation made at the first Materials Summit was the need to consolidate the materials community, as evidenced by the lack of

1 http://www.bmbf.de/pub/hts_fortschrittsbericht.pdf

2 http://ec.europa.eu/research/industrial_technologies/materials-blog_en.html

3 COM(2009) 512 final

4 http://ec.europa.eu/enterprise/sectors/ict/files/hlg_members_website_en.pdf

5 http://ec.europa.eu/enterprise/sectors/ict/files/kets/hlg_report_final_en.pdf

contacts throughout the community in the past – a key step towards which considerable progress has been made between the first and second Materials Summits. During this period, a common proposal for setting up a Knowledge and Innovation Community (KIC) for materials was jointly put forward by representatives of the European Technology Platform for Materials (EuMat), the European Materials Research Society (E-MRS), the Federation of European Materials Societies (FEMS), and the European Materials Forum (EMF). The Alliance for Materials (A4M) – a value chain approach to materials research and innovation – was launched, as well as its implementation in

the form of the coordination action for the networking of main materials collective stakeholders in materials science and engineering (Mat-Val). In July 2012, a workshop on Materials for the 2020 Challenges took place at the European Parliament in Brussels, to discuss the role of Materials as a key enabler element for boosting the industrial and technological growth in Europe. The workshop was organised by STOA (the Parliament's own Science and Technology Options Assessment body), together with four organisations representing the science and technology materials community at European level: E-MRS, FEMS, EMF, and EuMat.

Outlook for the future

The Commission proposal for the next framework programme for research, development and innovation, Horizon 2020, is designed to address the important challenges for Europe through funding excellent science, technology and innovation. It is central to the Europe 2020 Strategy for smart, sustainable and inclusive growth, the Innovation Union flagship to create a knowledge-intensive society, and the goal to complete the European Research Area as a single market for knowledge. Horizon 2020 will bring together EU level research and innovation funding into a single programme, covering the current 7th Framework Programme (FP7), innovation activities from the Competitiveness and Innovation Framework Programme, as well as EU funding to the European Institute of Innovation and Technology. Activities that were previously separate will be brought together to focus on societal challenges such as health, clean energy and transport. Horizon 2020 will enlarge the support traditionally given through FP7 to downstream activities, in order to help overcome the so-called “death valley” and facilitate the

adoption of new technologies by industry, e.g. by financing pilot or demonstration projects where appropriate. Horizon 2020 will be complemented by support to the European Research Area (ERA) and with reinforced synergy with Member States and the private sector, as well as with the new proposed programme for the competitiveness of enterprises and small or medium enterprises (SMEs) (COSME).

The KETs – of which materials are one – underpin innovation across industries and sectors, and the competitiveness and sustainability of the European industrial economy. As materials R&D&I is present virtually in the entire range of industrial research activities from enabling research to applications and demonstration activities, support to materials R&D&I can be found throughout the whole Horizon 2020 such as in the ERC, the FET programme, Leadership in Enabling and Industrial Technologies (LEIT), Societal Challenges and the European Institute of Innovation and Technology (EIT).

The Materials Summit 2012

The Materials Summit 2012 brought together representatives of main industrial and research stakeholders (see attached list of attendees) to discuss a strategic and modern vision of optimal features for materials R&D&I. The summit analysed and assessed the effectiveness of the support to materials research and innovation to date, and explored possible options for the future. Some of the issues addressed were the further structuring of the materials community, the best way of consulting stakeholders in order to prioritise and elaborate yearly work-programmes, how to achieve a winning combination of scientific and industrial advances, how to maximise the positive impact of the R&D&I support for the growth, competitiveness and sustainability of the EU industry, how to maximise the return for the taxpayers' money invested.

The main considerations and recommendations that were expressed by the participants at the Summit are the following:

General approach

- The context of the recent financial (and economic) crisis highlighted the value of the role of researchers and innovators in generating sustainable and long-lasting

wealth in Europe. More and more, scientists and industries are requested to be responsible and accountable in view of societal needs.

- To increase the effectiveness of the R&D&I activities it is important to favour a transition from project-driven to programme-driven support, to reinforce synergy with Member States, especially through ERANETs and – increasingly – through European innovation partnerships and joint programming, as well as to favour increasing integration and collaborations between academic scientists and industries, without forgetting the relevant role that SMEs will have in bringing new ideas and concepts to the market.
- Beyond the stage of “blue sky” research, in order to promote novelty and boost the time-to-market of new ideas, it is necessary to foster a change of mindset, from creating new materials to creating new solutions, with a focus on “materials for something” rather than on materials *per se*.
- While recognizing the value of the three-stage R&D&I model discussed in the first Materials Summit, all stages cannot usu-

ally be adequately addressed in a single project. Basic research will still be required, but the fact that Horizon 2020 is moving towards industrial reality is appreciated. There must also be room for incremental applied research that brings more innovation into already existing technologies. Materials need to be integrated into the value chain. Research and innovation can have different drivers. Public-private partnerships (PPPs) are a valuable tool that can be flexibly adapted to the most urgent needs, when industry's commitment is solid.

- The value chain should stay in Europe. Research focus should be on areas where Europe has strengths, and where there is likelihood that industrial production will take place in Europe. The focus should be on maximising outputs and gains, rather than on doing what others already do better.
- International cooperation is encouraged to accelerate progress, but should be instrumental to enable “things to happen” in Europe.
- Materials R&D&I can be found throughout the whole (proposed) Horizon 2020 such as in the European Research Council (ERC), Future and Emerging Technologies (FET), Leadership in Enabling and Industrial Technologies (LEIT), Societal Challenges and the European Institute of Innovation and Technology (EIT). The “completeness” of Horizon 2020 is acknowledged, but prioritisations remain open in the original EC proposal.
- Horizon 2020 will be an extremely powerful and promising support scheme to R&D&I, but not the only one within the EU. Synergy should be found also with other schemes such as structural funds, LIFE+ etc., and with activities supported by Member States.
- There is an important need for monitoring – a “control tower” was mentioned, in order to secure coherence, maximise impact and avoid gaps or duplications. The European Commission (EC) is encouraged to continue promoting and supporting the interaction and coordination of all stakeholders in materials science and engineering R&D&I.
- To this purpose, future activities should support monitoring, assessment, benchmarking, road mapping, foresight, coordination, organisation of events, communication and optimisation of interventions, for instance via appropriate and continuous coordination and support actions (CSAs). These should address (i) the socio-economic, industrial and research realities as well as (ii) the activities carried out within Horizon 2020 and (iii) outside it, through other EU schemes such as the structural funds and national activities, and (iv) benchmarking with research carried out outside Europe and how R&D&I are supported.

Implementation

- To focus on “materials by design”, to ensure that the best materials are produced for use, their reliable in-service performance, affordable cost and real sustainability; the importance of modelling is noted in this context. Ideally, a novel material should be devised when conceiving a new product; processing should also be addressed, thus ensuring both novelty for the solution developed and rapidity of its industrial take-up.
- To follow an integrated approach, to include consideration of the end-of-life of the products/materials and all by-products (e.g. so-called waste or pollution) as much as possible, in order to vigorously contribute to a really sustainable industrial economy.

- To integrate all KETs as much as possible and in particular materials with nanotechnology, as in the perspective of the year 2020 such a distinction fades dramatically.
- According to the “matrix” model mentioned in the first Materials Summit, research and networking in materials R&D&I should be both along the value chain and multi-sectorial, transverse and cross-cutting.
- In the “vertical” projects, conceived along the value chain, support within the LEIT pillar should achieve an increase of the Technology Readiness Level (TRL), expectedly from TRL 2 or 3 (e.g. arising from university or ERC/FET supported research) up to level 6 and in some cases even 7.
- The integration of novel materials into systems and support to prototyping should be included as far as possible in the projects.
- In the “horizontal” projects, technology-driven acceleration should be boosted with validation and pilot testing in as many application areas as possible. In a pre-industrialisation stage the follow-up of the potential applied projects towards market should involve highly flexible entities (SME, start-up, etc.). This could be performed via prototype/pilot lines. The mechanism to implement this action should be coordinated with the R&D&I of the Member States and their vision for sustainable knowledge-based growth. The possible synergy with structural funds should be explored.
- Excellence in research must continue to be promoted. Innovation should be able to follow research results swiftly. The participants acknowledge the progress achieved by the EC in FP7 work programme over the last years.
- Education and training should be part of the projects in order to help academia in delivering scientists and technologists who can match the future needs of society and industry. Continuous training should not be neglected.
- In addition, projects should also develop a culture of understanding the importance of industrial/intellectual property rights (IPR). Innovation management should be added to projects. Technology failure is normally not the first reason for the lack of success of new spin-offs or start-ups. The value of the Exploitation Strategy and Innovation Consultants (ESIC) support action in FP7 is recalled.
- How to encourage academics to approach industry? How to encourage industry to engage with academia? Projects should foster interactions in order to originate scientific questions and promote discoveries as well as boosting industrial competitiveness and the achievement of socio-economic targets.
- Coordination with Member States’ and Associated Countries’ activities should be boosted. The value of ERANET and ERANET+ schemes was mentioned. More flexibility in the ERANET+ scheme would improve its efficiency.
- As mentioned above, priority topics should be selected within an approach of programme-driven support to R&D&I, in line with the EU policies. Roadmaps and foresight studies should be developed when realistically possible. The actual value of the recommended areas of application indicated by the competent FP7 advisory group⁶ is confirmed, namely materials for health, information and communication technologies, energy, transport and environment, but further prioritisation is encouraged.

6 http://ec.europa.eu/research/industrial_technologies/pdf/nmp-expert-advisory-group-report_en.pdf

- The value of the materials roadmap for enabling low-carbon technologies⁷ is highlighted and the definition of other roadmaps is recommended, first of all for biomaterials for medical applications.
- Examples of future value chain “vertical” priorities can be: (i) materials for energy, (ii) decarbonisation of the European industry (including materials for green transport, materials for green energy, energy efficient buildings, use of CO₂ as a carbon base in industrial processes), (iii) renovation of metallurgy in Europe, (iv) independence of raw materials supply (including the reduction of use or substitution of critical or rare raw materials or precursors), (v) opening new business lines for European industry, centred on materials science and engineering (including the support to the “creative industries”), (vi) supply of appropriate clean water (including the development of membranes and catalysers), (vii) maintaining the European cultural heritage, (viii) metrology and standardisation.
- Support to multi-sectorial multi-application “horizontal” R&D&I projects should be secured as well, as mentioned above. Examples can be: joining different materials, self-healing materials, multi-scale modelling etc.
- R&D&I should address modernising existing industries via adding value and service content or increasing sustainability and reducing the carbon fingerprint and/or building new companies. The value of creativity-driven innovation, both in existing and new industries, was highlighted.

Financing and management

- Materials science and engineering activities are risky. There is normally no patient money in the private funding of new industrial or commercial activities based upon new technologies. Most projects funded by venture capital enterprises do not originate profitable businesses, and private funds follow commercial logic. The strategic importance of public schemes like Horizon 2020 is highlighted by the participants.
- In order to be manageable, projects must be limited in time and deliverables (usual time limit of 3-4 years). This causes limited possibilities for continuous funding throughout the innovation process. Follow-up activities should be foreseen, e.g. a mechanism to revisit certain projects after the 3rd year. An appropriate top-up funding mechanism should be introduced by the EC. Revolving funds to reduce marked risk may be an idea to explore.
- Funding should be used to secure reliability and reduce the time to market of the new technologies by reducing the technological risk. The problems are complex and managing complexity means managing partnership. This is particularly essential for start-up companies, e.g. for production and initial customer/distribution partners, and related IPR issues. Capital is thus a means of bringing partners to a table for the negotiation of roles and rights, for a commercial success of the new technologies.
- In defining and implementing Horizon 2020, simplification is greatly encouraged.
- The (financial) dimension of projects should be appropriate to the TRL and the ambition of the projects themselves. For instance, larger projects can address higher TRLs whilst small projects can be more adequate at lower TRLs, and a bottom-up approach could be favoured. In materials science there can be unexpected discoveries with

7 http://ec.europa.eu/research/industrial_technologies/pdf/materials-roadmap-elcet-13122011_en.pdf

huge impact, so that flexible mechanisms to accommodate these should exist.

- The EC should (test the) use of all the instruments foreseen in the Horizon 2020 tool box for supporting materials R&D&I, such as grants, prizes, public procurement, public-public and public-private partnerships. If the implementation modes are yet not mature (e.g. for the public procurement), studies to define the best features should be launched with priority. Prizes could be

used to support innovation in the creative industries, via fostering interaction of materials scientists and designers.

The participants of the Materials Summit 2012 submit these considerations and recommendations to the European Commission as an input for defining more effective and efficient R&D&I support measures to the benefit of the quality of life of the European citizens and of a more competitive, sustainable and inclusive industrial economy.

Annexes

Agenda of the Materials Summit.

List of experts endorsing this report and addressing it to the European Commission.

Participants from the European Commission.

Agenda of the Materials Summit

10th September 2012, rue du Champ de Mars 21, Brussels, room SDR2

AGENDA

- 09:30 Welcome coffee
- 10:00 Opening and introduction: Renzo Tomellini, European Commission
- 10:30 Keynote speech 1: 'Recommendations of a financial actor'
by Jens Petter Falck, Incitia
- 10:50 Keynote speech 2: 'Recommendations of a materials research society'
by Rodrigo Martins, European Materials Research Society
- 11:10 Keynote speech 3: 'Recommendations of a research organisation'
by Claudine Schmidt-Lainé, CNRS
- 11:30 Keynote speech 4: 'Recommendations of an industrial sector'
by Gernot Klotz, SusChem
- 11:50 'Examples of networks of stakeholders: the Alliance for Materials (A4M), MatVal'
by Marco Falzetti, CSM
- 12:10 Buffet lunch
- 13:45 Open discussion
- 15:45 Conclusions
- 16:00 Closing remarks
- Meeting ends

List of experts endorsing this report and addressing it to the European Commission

Derk BOL	M2i
Harald BOLT	Forschungszentrum Jülich
Patrick BRESSLER	MatSEEC
Barbara CASTELLANO	SORIN
Gabriel CREAN	CEA
Sue DUNKERTON	TWI
Jens Petter FALCK	Incitia
Marco FALZETTI	MatVal
Burkhard JAHNEN	DFG/M-ERANET
Michal KLEIBER	EMF
Gernot KLOTZ	CEFIC/SusChem
Jacques KOMORNICKI	CEFIC/SusChem
Rodrigo MARTINS	E-MRS
Hernan MIGUEZ	CSIC
Paul MIJLEMANS	UMICORE
Luigi NICOLAIS	CNR
Daniele PULLINI	CRF
Gian Marco REVEL	UNIVPM
Peter RIGBY	EMIRI
Claudine SCHMIDT-LAINÉ	CNRS
Sisko SIPILÄ	TEKES/MATERA+
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The next The EU Framework Programme for Research and Innovation, Horizon 2020, will address the important challenges for Europe through funding excellent science, technology and innovation. R&D&I on Advanced Materials will be a key element in the entire range of industrial research activities, from enabling research to applications and demonstration activities.

In September 2012 the European Commission organised a Materials Summit, bringing together representatives of main industrial and research stakeholders to discuss a strategic and modern vision of optimal features for materials R&D&I. The summit analysed and assessed the effectiveness of the support to materials research and innovation to date, and explored possible options for the future. This report contains the main considerations and recommendations that were expressed by the participants at the Summit.

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