



European Commission



European Materials Forum

## Lisbon 2007 Declaration

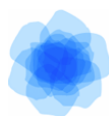
On

# International Cooperation in Materials Research: Key to Meeting Energy Needs and Addressing Climate Change

## Conclusions of the First World Materials Summit

Held under the auspices of:  
Portuguese European Presidency

Lisbon - 5<sup>th</sup> October 2007



PORTUGAL 2007

Presidência Portuguesa da União Europeia 2007 - Evento de interesse científico - Ciência 2007UE

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# Materials Scientists Unite to Combat Climate Change

## “LISBON 2007”

Top materials scientists from around the world met under the auspices of the Portuguese European Presidency in Lisbon on October 4<sup>th</sup>/5<sup>th</sup> to tackle the problem of climate change. Selected delegates from all around the world discussed how best to reduce CO<sub>2</sub> emissions during energy production and use, by means of new and innovative materials and processes. Industry, university, and government representatives examined possible strategies for low emission energy technologies including solar energy, wind power, biofuels, hydrogen fuel cells, and nuclear fission and fusion. Each of these technologies requires new and improved materials to increase the efficiency and reliability, to decrease greenhouse gas emissions, to reduce capital costs, and to extend service lifetime. The meeting concluded that the present pace of research and development is too slow to meet the needs of the world's rapidly growing and increasingly energy-hungry population. The efforts are too fragmented, and the competition between different laboratories and institutions hindered progress on complex problems where international cooperation is vital for achieving breakthroughs. In a final plenary session, the scientists present unanimously agreed to set up a new global networking initiative to coordinate and accelerate efforts in this area. **The global network, CORME\* (Coordination of Research on Materials for Energy) will be organized by the International Union of Materials Research Societies (IUMRS), working in conjunction with regional and national Materials Research Societies and related bodies. For Europe, the European Materials Forum (EMF) a grouping of most of the materials actors will coordinate. CORME will have the following objectives:**

- (1) To produce internationally agreed strategic plans (“road maps”) for the development of new and improved materials and the products for future energy technologies.
- (2) To bring together leading academic, public sector and industrial scientists in a series of focused workshop meetings to discuss important technical issues and to ensure that key problems are tackled in a swift and effective manner. Several topics have already been selected and the agenda been prepared:
  - Transformation and recycling of CO<sub>2</sub> into a new raw material,
  - Hydrogen generation and storage,
  - Clean Coal Technology,
  - Nuclear energy: Fusion and Fission, in particular for hydrogen production
  - Fuel Cell Technologies (Sydney 2008)
- (3) To identify and train a new generation of young international leaders for leveraging materials science and technology for clean energy research and development.

\* *corme* is a tube-like structure which occurs in certain plants and stores fuel and energy. Grow it, and it produces a beautiful flower – e.g. a crocus or gladiolus

- (4) To promote major new international collaborative materials research programmes relevant to future energy technologies.
- (5) To provide information to global, regional and national policy makers and investment analysts in the energy sector.
- (6) To ensure that manufacturers in the energy sector, especially SME's (Small and Medium Enterprises), have the best possible access to information related to innovative materials developments.
- (7) To interface with other key international organizations relevant to the energy sector or involved in energy-related materials research.
- (8) To stimulate public interest in, and awareness of the significance of energy-related issues.
- (9) To attract and nurture young generation of scientists and engineers to meet the mega challenge of clean energy sustainability and growth through providing a clear picture of the challenge, opportunities and career path.

The First World Materials Summit was held at Hotel Corinthia in Lisbon, Portugal, on 4<sup>th</sup> – 5<sup>th</sup> October 2007, with the theme “Materials Research: Key to Meeting Energy Needs and Climate Change”. The scientific programme was organized by the European Materials Forum (EMF).

**CONTRIBUTORS:**

- Presidência Portuguesa da União Europeia 2007
- International Union of Materials Research Societies (IUMRS):
  - A-MRS (Materials Research Society of Australia)
  - B-MRS (Brazil Materials Research Society)
  - C-MRS (Chinese Materials Research Society)
  - E-MRS (European Materials Research Society)
  - MRS (Materials Research Society, USA)
  - MRS-T (Materials Research Society of Taiwan)
- Federation of European Materials Societies (FEMS):
  - DGM
  - Sociedade Portuguesa de Materiais (SPM)
- European Science Foundation (ESF)
- ALSTOM
- European Technology Platform on Advanced Engineering Materials and Technologies (EuMaT)

**EMF:**

The European Materials Forum “EMF” is a non profit organization integrating the major materials related scientific organizations in Europe, as well as certain industries. The founding members include:

- All European Academies (ALLEA)
- European Academy of Sciences and Arts (EASA)
- European Federation of Scientific and Technical Networks of Cooperation (FER)
- European Materials Research Society (E-MRS)
- European Neutron Scattering Association (ENSA)
- European Physical Society (EPS)
- European Science Foundation (ESF)
- European Science-Industry Consortium for Biomaterials & Health Care (EUROBIOMATEX)
- European Science and Technology Universities
- Euroscience
- Federation of European Materials Societies (FEMS)
- Freiburger Materialforschungszentrum (FMF)
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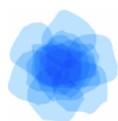


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## APPENDICES



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# Appendix 1

## INTRODUCTION

- ◇ The scientific evidence is now overwhelming: climate change is a serious global threat, and it demands an urgent global response. (Intergovernmental Panel on Climate Change (IPCC) / UNEP<sup>1</sup>-WMO<sup>2</sup>)
- ◇ Climate change will affect the basic elements of life for people around the world: access to water, food production, health and the environment. Hundreds of millions of people could suffer from hunger; water shortages or coastal and inland flooding, as the world warms. (N. Stern<sup>3</sup>: Report to British Government)
- ◇ Every country will be affected, starting with the poorest
- ◇ A range of options exists to cut emissions, but strong and decisive policy actions are required to motivate their take-up.
- ◇ Climate change demands an international response, based on a shared understanding of long term goals and agreements on the frameworks for action.

Among the key elements of future international frameworks is the need for strong technology cooperation and formal agreements to boost the effectiveness of investments in research and innovation.

<sup>1</sup>: UNEP: United Nations Environmental Programme

<sup>2</sup>: WMO: World Meteorological Organisation

<sup>3</sup>: N. Stern: former chief economist World Bank

## **THE IMPORTANCE OF MATERIALS**

Advanced materials, materials research and innovation are probably the most important elements needed to develop the required new technologies to provide a clean reliable energy supply with a significant reduction in CO<sub>2</sub> emissions. New concepts, as well as closer collaboration between all researchers and relevant institutions in all the countries of the world, are essential.

## **THE MATERIALS SCIENTIFIC COMMUNITY**

The scientific materials community in Research, Development and Technology is well organized, both at the European level and at the wider International level:

- ◇ The EUROPEAN MATERIALS FORUM (EMF) brings together over 120 national and European scientific societies active in the field of advanced materials. The EuMaT Technology Platform has assembled over 700 members from both industry and academia and several other European Technological Platforms consider more specific questions.
- ◇ At the world level the INTERNATIONAL UNION OF MATERIALS RESEARCH SOCIETIES (IUMRS) has been created on the basis of the multidisciplinary model created in the USA by the Materials Research Society (MRS), the effectiveness of which has led to the creation of similar structures all over the world: from North and South America to Europe, Russia , P.R. China, Taiwan, India, Japan and Australia.

# Appendix 2

## GENERAL CONSIDERATIONS

1. Current projections estimate that the energy needs of the world will more than double by the year 2050. This will be coupled with increasing demands for clean energy. These demands cannot be met by existing technologies.
2. Advanced materials technologies have already demonstrated (e.g. GaN for lighting) the ability to make a significant contribution to the reduction of CO<sub>2</sub>.
3. The key objectives that have been proposed:
  - a. A target of 20-20-20, which translates to: that by 2020, we should have reduced the total primary energy consumption by 20% and achieved 20% of the overall energy mix from renewable energy sources - the Intergovernmental Panel on Climate Change (IPCC).
  - b. A "reduction by a factor of 2 in the annual emissions of greenhouse gases by 2050 - the Nairobi Climate Conference in November 2006<sup>1</sup>
4. Considering the urgency of the energy problem, the magnitude of the needed scientific breakthroughs to achieve the above targets and the current rate of scientific discovery, current efforts will likely be too little, too late. Multifold enhanced fundamental materials research effort is needed immediately, since at least twenty years are often necessary to transform a discovery in an industrial product.
5. A new and sustained collaborative international interdisciplinary materials research is, therefore, essential to provide the breakthroughs required looking for synergy and "critical mass notion".

<sup>1</sup>: Developed countries should have a factor of 3-4 reduction to allow the developing ones to progress faster.

# Appendix 3

## OUR CONSIDERATIONS

To confirm this strategy, the World Materials Summit at Lisbon in October 2007 collected proposals to best achieve the essential acceleration of development by the worldwide materials science and technology community:

### 1. **Present technologies do not enable fossil fuels to be eliminated**

With the ever growing demand for increasing the supply of energy it is evident, that for the foreseeable future, the currently used technologies make it impractical to eliminate fossil fuels. However, whilst continuing to use fossil fuel resources they must be employed with greater efficiency and responsibility<sup>1</sup>.

The optimum way to overcome the problem is the rapid development of new materials and technologies and to ensure their application to achieve reduced energy consumption in all commercial and domestic sectors, i.e. buildings, transport, equipment manufacture and service industries. The World Summit 2007 proposes to establish a **Materials Research and Technology Milestone Agenda** for a coordinated roadmap for international collaboration in fundamental research, especially oriented to transport.

### 2. **Advanced materials can contribute to the reduction of CO<sub>2</sub> emissions**

To promote the expansion of the world economy without harming the environment, technologies to increase the efficient use of energy must be developed. New concepts are required to increase energy efficiency, to reduce the emission of pollutants to the environment and to monitor the causes of environmental destruction. In all these processes materials play the fundamental role. Therefore the World Materials Summit 2007 proposes to extract from the numerous proposals formulated throughout the world the essential directions to be developed collaboratively. The expected innovations arising from the fundamental programmes can generate a strong economical development in totally new domains.

<sup>1</sup>: Fossil fuels are still largely available, however, they are also the basis of organic chemistry, a much "nobler" application

**3. Fundamental research is needed for innovative new technologies** – an urgent paradigm shift for development

Generally, basic research makes major contributions to the solution of the most complex technological issues. However in order to get truly innovative novel technologies, 'breakthroughs', a paradigm-shift is necessary.

The World Materials Summit 2007 proposes that, in the field of fundamental research, the essential goals for new development shall be articulated (e.g. a target to lower the material costs for fuel cells by 90%) and from the mass of applications for funding, the "projects of urgency to save the planet" that are proposed to politicians, industry deciders and research communities should be adequately financed. The possible use of CO<sub>2</sub> as a resource, rather than it being a problem, by recycling it into a C-H compound would completely change the current situation. However, the required technologies need to be developed and they will need fundamental breakthroughs if they are to be achieved.

**4. The present technologies cannot generate hydrogen without CO<sub>2</sub> emission**

The Hydrogen Society regarding the mobility of people was one of the focussed items of the World Materials Summit. Enormous progress has been made in fuel cell technology, especially those operating with Hydrogen. Cars and buses are already in service to demonstrate the concepts in several parts of the world. A technologically satisfactory method for the storage of hydrogen has still not been achieved for mass production and new concepts and materials are drastically necessary to reduce the costs if the widespread use of the technology is to be promoted. The acceptable cost of fuel cells is currently far too high and the production and storage of hydrogen in a clean and safe manner are largely open questions, although the solution is certainly one based on materials.

**5. Only solar, nuclear and bio-energy can generate power with low emissions of CO<sub>2</sub>: the need for a reflected medium term agenda**

It is apparent that the worldwide shift towards non-emitting CO<sub>2</sub>-energy production is inevitable and immediate actions must be commenced. Therefore, only solar energy as well as the further controlled use of nuclear energy is vital, but in the long term bio may be an alternative. A combination of nuclear and solar methods is likely

to be an efficient method for producing electricity and thence hydrogen free of CO<sub>2</sub> emissions.

## **6. The cutting objectives by 2020 – political commands and highly focused development**

When the current international commitments are renewed in 2012, the EU will require the developed countries to collectively reduce their emissions of greenhouse gases by 2020 to an amount 20% less than that projected for 2020. Irrespective of what other countries do, the EU has made a firm independent commitment to achieve this reduction by 2020 which is 30% less than the 1990 level.

The actual goals, often phrased by 20:20:20 are

1. saving 20% of energy consumption compared to projections for 2020;
2. increasing to 20% by 2020 the share of renewable energies in overall energy consumption;
3. cutting greenhouse gas emissions by at least 20% by 2020

In addition the EU proposes an increase in the amount of biofuel in the overall consumption of petrol and diesel fuel to at least 10% by 2020, a better integration of EU energy markets, a better integration of EU energy policy with other policies, such as agriculture and trade and finally more international cooperation. If the EU can take a common approach on energy and articulate it with a common voice, it can lead global debate.

In order to achieve the goals of CO<sub>2</sub> emissions for the Planet Earth, the Global Materials Research Community can make a major contribution by developing novel materials and related technologies. This summit proposes close worldwide cooperation between all related consortia in which the development of novel materials and processes must be realised in order to achieve the necessary industrial innovation.

## **7. International cooperation for breakthrough: networks with full cooperation need to be established**

The key to finding new materials, possessing superior properties to those currently available, rests, not only on developments based on what we know, but by obtaining novel materials from simulation, modelling and experimentation. To win its battle against the perils of CO<sub>2</sub> emission the world needs to change the paradigm of technologies.

It is proposed that the International Union of Materials Research Societies, associated with the regional member societies takes care of the world related questions, with the European Materials Forum being responsible for the European materials science community.

Collectively the cooperation should be within the group  
**“Coordination Research on Materials for Energy” – CORME**

**8. Education and Training**

Due to the complexity and multi-disciplinary nature of the problems to be solved, it is important to develop appropriate e-learning programmes as well as direct contacts between industry and the research community. These should be through small specific exchanges and workshops for which a model has already been tested and proved successful by IUMRS.

# Appendix 4

## **ACTION PLAN FOR CORME**

The participants reached the **following agreements**:

1. Agreement to enhance international research collaboration in energy-related materials research, in order to expedite progress.
2. Agreement to share results at the earliest possible stage, before publication if appropriate.
3. Agreement to meet regularly on a sector-by-sector basis to review progress.
4. Agreement to exchange knowledge and expertise (and researchers?) between laboratories.
5. Agreement to stimulate more collaborative research proposals
6. Agreement to lobby for greater national and international funding for this area.
7. Agreement to use the infrastructure of IUMRS/EMRS etc. as a framework for the organisation of focused workshops and conferences.
8. Agreement to pursue the concept of a COST-type action programme to coordinate and fund the above actions.

Proposed **Action Plan**:

### **1. ORGANISATION OF THEMATIC GROUPS FOR FUNDAMENTAL RESEARCH IN MATERIALS SCIENCE**

- A. Low Cost Components for Fuel Cells
- B. Safe Hydrogen Storage
- C. High Security Structural Materials
- D. Batteries and Supercapacitors
- E. Efficient Hydrogen Generation
- F. Materials Recycling
- G. Advanced Electronic Motors
- H. High Power Electronics
- I. Low Cost Solar Cells
- J. Reinforced Composites for Aircraft
- K. Education and Training
- L. Nurturing Future Leaders in Energy Materials

### **2. PREPARATION OF A MILESTONE AGENDA FOR THESE TOPICS**

### **3. ORGANISATION OF MULTIDISCIPLINARY EXCHANGE OF INFORMATION between research, industry and education**

N.B. Regarding NUCLEAR ORIENTED MATERIALS the international community is already organised within International Atomic Energy Agency, the "International Forum on Generation IV reactors (President M. J. BOUCHARD) and the ITER Programme, Materials Division.