

Chapter 5 IUMRS Conferences

5.1 Introduction to IUMRS Series Conferences

The academic exchange between the materials scientists in the world is one of the most important activities of IUMRS. Five IUMRS conferences/forums have been established during the last 30 years by IUMRS forerunners and successors. IUMRS Series Conferences include 1. IUMRS-ICAMs (International Conferences on Advanced Materials); 2. IUMRS-ICEMs (International Conferences on Electronic Materials); 3. IUMRS-ICAs (International Conferences in Asia); 4. IUMRS- World Materials Summit (WMS) and 5. IUMRS-ICYRAMs (International Conferences for Young Researchers on Advanced Materials).

Both IUMRS-ICAMs and IUMRS-ICEMs started in 1988 and were held in Japan mainly organized by MRS-Japan. Later on, these two conferences are held every two years (odd number year for IUMRS-ICAMs and even number year for IUMRS-ICEMs). Every IUMRS adhering body can apply to hold the conferences, and the conference organizing society will be decided by the voting of IUMRS adhering bodies. The formal IUMRS EC(executive members) meetings and GA (general assembly) meeting are held during these two conferences. The hosting society should provide the place and certain financial support for the EC and GA meetings.

IUMRS-ICA initiated at 1993, and the first conference was held in China, Sept. 1993 organized by C-MRS. Later on IUMRS-ICAs were held every year organized MRS-Taiwan, MRS-Korea, MRS-Japan and MRS-India, taking term by Asia members till 1998. After 2000 the conferences were held every two years for the second term, and the new members MRS-Singapore joined the second term. The third term and starting from 2010 returned to the role of one a year. The new members MRS-Indonesia, MRS-Australia and MRS-Thailand joined the third term.

IUMRS- WMS(World Materials Summit) started in 2007 and held every two years. The first summit was held in Lisbon, Portugal, Oct. 2007 organized by E-MRS, followed by second one in Suzhou, China, Oct. 2009 (C-MRS), third one in Washington DC, USA, Oct. 2011(MRS), fourth one in Strasburg, France, Oct. 2013(E-MRS), fifth one in Rizhao, Shandong, China, Oct. 2016 (C-MRS), sixth one in Strasburg, France, Oct. 2017(E-MRS) and eighth one in Hongzhou, China, Oct. 2019 (C-MRS).

IUMRS-ICYRAMs initiated at 2011 in the GA meeting in Nice. The aim of this new conference is to provide a platform for the young materials researchers in the world to exchange their recent research achievements as well as to strengthen the cooperation among young materials in the different countries and areas. The main organizers of the conference should be under the age of 40. The first conference (organized by MRS-Singapore) was held in Singapore, in July, 2012, followed by second one(by C-MRS) in Haikou, Hainan, China, Oct. 2014. Third (by MRS-India) and fourth (by Australia-MRS) ones were held in Bangalore, India, Oct.. 2016, and Adelaide, Australia, Sept. 2018. Due to the COVID-19 the fifth meeting (by E-MRS, in Warsaw, Poland, Sept. 2020) was postponed to 2022.



International Union of
Materials Research Society (IUMRS)

5.2 List of IUMRS-ICAMs (International Conferences on Advanced Materials)

	Time	Place	Hosting Society	Number of Sym- posia	Scale	Country/areas of Partici- pants From
1	1988	Tokyo, Japan	MRS-Japan	21	1665	24
2	1991	USA	MRS-USA			
3	1993	Tokyo, Japan	MRS-Japan	37	2200	
4	1995	Cancun, Mexico	MRS-Mexico	35	1000	
5	June14-18, 1999	Beijing, China	C-MRS	36	2000	45
6	2001	Cancun, Mexico	MRS-Mexico			
7	2003	Yokohama, Japan	MRS-Japan	39	2100	34
8	2005	Singapore	MRS-Singapore	25	2000	
9	2007	Bangalore, India	MRS-India	24		
10	2009	Rio, Brazil	MRS- Brazil			
11	May 2011	Nice, France	E-MRS		3000	
12	Sept.22-28, 2013	Qingdao, China	C-MRS	33	2500	34
13	2015	Jeju, Korea	MRS-Korea	38	1527	38
14	2017	Kyoto, Japan	MRS-Japan	30	1878	44
15	May, 2019	Nice, France	E-MRS	28+5	3500	
15	2021	Cancun, Mexico	MRS-Mexico			

5.3 List of IUMRS-ICEMs(International Conferences on Electronic Materials)

	Time	Place	Hosting Society	Number of Sym- posia	Scale	Country/areas of Partici- pants From
1	1988	Japan	MRS-Japan			
2	1990	Francisco, USA	MRS			
3	1992	Strasbourg, France	E-MRS			
4	1994	Hsinchu, Taiwan	MRS-Taiwan	8	520	29
5	1996	USA	MRS			
6	1998	Jeju, Korea	MRS-Korea	9	443	20
7	2000	Strasbourg, France	E-MRS			
8	June14-18, 2002	Xi'an, China	C-MRS	14	800	28
9	2004	San Francisco,USA	MRS			
10	2006	Nice, France	E-MRS			
11	2008	Sydney, Australia	A-MRS	19+2	1000	
12	2010	Seoul, Korea	MRS-Korea	22	1077	22
13	2012	Yokohama, Japan	MRS-Japan	39	1811	35

Chapter 5 IUMRS Conferences

	Time	Place	Hosting Society	Number of Symposia	Scale	Country/areas of Participants From
14	2014	Taipei, Taiwan	MRS-Taiwan			
15	2016	Singapore	MRS-Singapore			
15	2018	Taejon, Korea	MRS-Korea	29	1163	36
16	2020	Iguassu Falls, Brazil	MRS-Brazil (postponed to 2021 due to COVID-19)			

5.4 List of IUMRS-ICAs (International Conferences in Asia)

	Time	Place	Hosting Society	Number of Symp	Scale
1	Sept. 1993	Yangtze River, China	C-MRS		180
2	1994	Hsinchu, Taiwan	MRS-Taiwan	5	271
3	1995	Seoul, Korea	MRS-Korea		
4	1997	Makuhari, Japan	MRS-Japan	22	1280
5	1998	Bangalore, India	MRS-India		
6	July 24-26, 2000	Hongkong	C-MRS		700
7	2003	Singapore	MRS-Singapore		
8	2004	Hsinchu, Taiwan	MRS-Taiwan		
9	2006	Jeju, Korea	MRS-Korea	17	1306
10	2008	Nagoya, Japan	MRS-Japan	38	1754
11	2009	Singapore	MRS-Singapore		
12	Sept. 25-28, 2010	Qingdao, China	C-MRS	17	1800
13	2011	Taipei	MRS-Taiwan		
14	2012	Busan Korea	MRS-Korea	21	1603
15	2013	Bangalore, India	MRS-India		
15	2014	Fukuoka, Japan	MRS-Japan	50	1933
16	2015	Singapore	MRS-Singapore		
17	Oct.20-24 2016	Qingdao, China	C-MRS	28	2500
18	2017	Taipei	MRS-Taiwan		
19	2018	Bali, Indonesia	MRS- Indonesia	27	
20	2019	Perth, Australia	MRS-Australia	38	500
21	2020	Thailand	MRS-Thailand		
22	2021	Korea	MRS-Korea		



International Union of
Materials Research Society (IUMRS)

5.5 IUMRS-ICYRAMs (International Conferences for Young Researchers on Advanced Materials)

5.5.1 List of IUMRS-ICYRAMs

	Time	Place	Hosting Society	Number of Symposia	Scale
1	2012	Singapore	MRS-Singapore		800
2	2014	Haikou, China	C-MRS	15	1400
3	2016	Bangalore, India	MRS-India		1000
4	2018	Adelaide, Australia	MRS-Australia		300

5.5.2 Photo Collection of IUMRS-ICYRAMs

First IUMRS- ICYRAMs in Singapore, July 2012



Prof Tan Chorh Chuan, President of National University of Singapore and Prof B.V.R. Chowdari at the Opening Ceremony of IUMRS-ICYRAM on July 2, 2012



Prof Barry Halliwell, Deputy President of National University of Singapore awarded a medal of Young Research Awards for Prof Xiangfeng Duan at the Award Ceremony of IUMRS-ICYRAM on July 6, 2012

Second IUMRS- ICYRAMs in Haikou, Oct. 2014



Opening Ceremony and plenary session of IUMRS- ICYRAMs in Haikou, Oct. 25, 2014



President Prof. Osamu Takai and Prof. B.V.R. Chowdari awarded a medal of Young Research Awards for Prof. Ali Khademhosseini at the Second IUMRS-ICYRAMs in Haikou, Oct. 26, 2014



Excellent poster award winners of IUMRS- ICYRAMs, in Haikou, Oct. 26, 2014



Registration Desk of IUMRS- ICYRAMs in Haikou, Oct. 24-27, 2014



International Union of
Materials Research Society (IUMRS)



Parallel sessions of IUMRS- ICYRAMs in Haikou, Oct. 25-27, 2014

5.6 IUMRS- World Materials Summit (WMS)

5.6.1 List of IUMRS- (WMS)

	Time	Place	Theme	Hosting Society	Scale
1	Oct. 2007	Lisbon, Portugal	Materials and Sustainable Development	E-MRS	80
2	Oct. 2009	Suzhou, China	Renewable Energy Materials	C-MRS	130
3	Oct. 2011	Washington DC, USA	Materials for Energy and Environment Young Scholars Forum	MRS-USA	150
4	Oct. 2013	Strasbourg, France	Materials for Energy and Environment Young Scholars Forum	E-MRS	150
5	Oct. 2016	Rizhao, China	Materials for Energy and Environment	C-MRS	80
6	Nov. 2017	Strasbourg, France	New Frontier Material Young Scholars Forum	E-MRS	150
7	Oct. 2019	Hangzhou, China	New Frontier Material & the past and future of IUMRS	C-MRS	100

5.6.2 General information of IUMRS-World Materials Summits

The first world Materials Summit was held in 2007 in Lisbon, Portugal during the 6-month Portuguese Presidency of the European Union. In the preceding years there had been informal discussion between representatives of the adhering bodies during IUMRS meetings regarding the possibility of organizing conferences on the future energy supply on raw material, and critical materials supply, but no action was forthcoming. However, E-MRS considered that there was a real need to focus on the various current challenges facing the world for which there was currently no forum to facilitate discussion and proposing action so they took a double initiative:

-E-MRS launched an equivalent structure as IUMRS, but limited to European based learned societies acting in the field of materials at the European level with the title European Materials Forum (EMF). This title was officially deposited at the French National Institute of Industrial Property (INPI) on August 28th, 2007 (ref. 073521411)

The title World Materials Summit was deposited at INPI by E-MRS on August 28th, 2007 (ref. 073521412)

The concept, development, organization and implementation of the inaugural and highly successful inaugural World Materials Summit was entirely through the initiative of the European Materials Research Society, E-MRS, using the newly legalized EMF and under the umbrella of the European Commission. E-MRS also financed the event

without any external support. The Summit was opened by one of the three Presidents of EMF, Michal Kleiber, the former Polish Minister of Science and Scientific advisor to the President of Poland. The Summit was intended to be the means to bring together, by invitation only, experts and world leaders from academia, industry, together with the political decision makers involved in the key issues facing the world for which materials developments are essential to find sustainable solutions. Lisbon was selected as the venue because The Portuguese Commissioner of the European Union had responsibility for research and had announced enhanced funding for research and the Summit became one of the high profile events of the Portuguese EU Presidency.

Although the Summit was an EMF/E-MRS event invitation was sent to MRS, MRS-C and IUMRS representatives who all attended. It was hoped that the adhering bodies to the Society and the materials community at large may benefit from the initiative and any subsequent publicity. During discussions between the three societies, E-MRS, MRS and MRS-C during the Summit and the perceived evidence of its success it was agreed that future Summits would be held as a tri-partite initiative and that MRS-C would host second Summit in 2009 and that MRS, then still a member of IUMRS would host the third in 2011. However, it was also agreed that IUMRS will be a permanent invited guest.

Following the Summit in Lisbon the European Science Foundation offered to produce the report of the Summit. As already indicated above, at that time E-MRS was attempting to bring the various European Societies together to create a “materials community” single voice for influencing the policy and decision makers of the European Commission, through the European Materials Forum, EMF. The initiative was closely followed by the European Union, especially the Portuguese European Commissioner.

The Second Summit organized and hosted by MRS-C was held in Suzhou, China focusing on Advanced Materials in Energy Applications and Sustainable Society, October 12-15, 2009, Suzhou, China and collected scientific and technical reports and made recommendations on how to best achieve the essential acceleration of development by the worldwide materials science and technology community.

As agreed in 2007 the third summit was organized by MRS from October 9-12, 2011 in Washington, DC. This event introduced a student congress involving young researchers from around the world both to learn from the speakers at the Summit and to express their views on how they see the future.

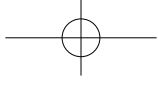
The 2013 Summit organized by E-MRS was held in Strasbourg from October 12th -15th and focused on Key Enabling Technology for Secure Energy & Sustainable Development. Following on from the highly successful Student Congress in Washington the Summit included a Forum for Next Generation Researchers which proved to be equally as successful as its predecessor in Washington.

The responsibility for organizing Summit number five returned to MRS-C and was held at Rizhao from 18th-20th October 2016 on Advanced Materials for Sustainable Society Development. As with all the Summits it was supported by speakers from IUMRS adhering bodies, but for various reasons could not incorporate the forum for worldwide young researchers.

As MRS had withdrawn from IUMRS and had declared that they could see no advantage in hosting and organizing of the Summit E-MRS organized the 6th Summit at the Council of Europe on 20th-21st November 2017 preceded by a two-day forum for the next generation of young researchers consisting of people selected by the various adhering bodies of IUMRS. The Summit addressed topics related to Materials Innovation for the Global Circular Economy and Sustainable Society.

The next Summit is being organized by MRS-C in Hangzhou from October 24-26th 2019. Twelve years after the inaugural summit the challenges are even more clear recognized and today include climate change, energy supply and storage, water, transportation, health and nutrition, recycling and natural resources. The need for the Summits to address these problems and urge the world's policy and decision makers to participate and then take real initiatives to address the issues is essential for the sustainability of human life worldwide.

Therefore, it is an essential task for our scientific community to develop and enhance the concept of the Summit so that it becomes a recognized and influential voice throughout the world.



International Union of
Materials Research Society (IUMRS)

5.6.3 Introduction to Second World Materials Summit

The concept of IUMRS World Materials Summits initiated in 2005. Professor Lian Zhou, the president of C-MRS and IUMRS at that time, lead several discussions during some informal IUMRS meetings in Beijing, Xian, Ningbo and Shanghai with the various IUMRS member societies about the future possible developments of the International Union of Materials Research Societies. During one evening boat tour on a lake close to Shanghai in 2005 the suggestion emerged of organizing conferences on the role of materials for future energy supply. Although Professor Zhou could not bring this concept to fruition, recognition of the strategic importance of materials for the future energy worldwide supply led to E-MRS deciding to begin the organization of the First World Materials Summit for Energy, with the support of the newly elected President of IUMRS, Professor Gabriel Crean. The inaugural summit was held in Lisbon, Portugal, 4-5th October 2007, coinciding with the Portuguese Presidency of the European Union.

The Second World Materials summit was held in the Shilla Hotel, Suzhou Industrial Park, Suzhou, Jiangsu province, Oct. 12-15, 2009 and sponsored and organized by C-MRS, E-MRS, MRS and IUMRS, and the Chair of the summit was Prof. Kuangdi XU, Academician and President of CAE, and Co-Chairs were Prof. Boyun Huang (Academician of CAE, and President of C-MRS) and Paul Siffert (Past president of IUMRS and E-MRS).

The theme for the summit was “Advanced Energy Materials and Sustainable Development of Society”. The current industrial status, recent research achievements, and government policies in the field of advanced materials for energy application were presented. The main technical topics included, but not limited to, the six topics of Solar energy and photovoltaic cell materials, Nuclear energy materials, Hydrogen energy related materials and fuel cells, Large scale energy storage and battery materials, the materials for bio-energy, and Alternate energy sources and transmission.

130 top scientists, entrepreneurs and government officers from 18 countries and regions attended the Summit, 51 from C-MRS, 28 from MRS, 22 from E-MRS, 9 from MRS-J, and 11 from MRS-T. The *Suzhou Declaration* was issued and published. The meeting concluded with the following findings:

“To meet the needs of sustainable development of society, new and multiple energy supplies with high-efficiency and low carbon emission are needed. However, the current technologies of renewable energy are not competitive in cost or performance. Advanced energy materials have already demonstrated a significant contribution to energy development and will play a fundamental role in further raising energy generation efficiency and reducing the costs of energy generation systems.

Compared to the urgency of energy and environmental problems, the present pace of research and development of advanced materials is too slow. Fragmented and duplicated research in the energy materials’ community inhibits its development. Innovation of advanced energy materials and a breakthrough in its effective integration into energy systems is essential to meet the needs of highly efficient and clean applications of energy production.

In order to integrate the research community and accelerate the rate of development of advanced energy materials, international collaboration is particularly crucial in the pre-competitive technology of advanced energy materials when focused on research, development, and demonstration of renewable energy. The following areas are recommended as collaborative areas of research and development:

- Materials for nuclear reactors
- Materials for thin film solar cells and solar thermal generators
- Materials for hydrogen-energy and fuel cells
- Materials for large-scale energy-storage technology
- Materials for biomass energy
- Regulations, codes and standards for novel energy materials

To ensure that international collaboration is effective and efficient, the financing of collaborative research and development projects and their working principles should be established under the road-map and coherent framework of the International Union of Materials Research Societies (IUMRS).



Group photo of 2nd IUMRS-World Materials Summit in Suzhou, Oct. 2009



Opening Ceremony of 2nd IUMRS-World Materials Summit in Suzhou, Oct. 13, 2009

Att. Suzhou 2009 Declaration on Enhancing Development of Advanced Energy Materials

From October 12 to October 15, 2009 the Chinese Materials Research Society (C-MRS) hosted the “Second World Materials Summit” in Suzhou, Jiangsu Province, China, on the topic of “Advanced Energy Materials and Sustainable Society Development.” More than one hundred distinguished scientists, government officials, and business leaders from all over the world came together to evaluate the current status of research and its application to advanced energy materials, to outline key issues and challenges in the development of advanced energy materials, envision their potential role in the development of nuclear and renewable energy, and discuss the paths to enhance the development of advanced energy materials.

The meeting concluded with the following findings:

1. To meet the needs of sustainable development of society, new and multiple energy supplies with high-efficiency and low carbon emission are needed. However, the current technologies of renewable energy are not competitive in cost or performance. Advanced energy materials have already demonstrated a significant contribution to energy development and will play a fundamental role in further raising energy generation efficiency and reducing the costs of energy generation systems.
2. Compared to the urgency of energy and environmental problems, the present pace of research and development of advanced materials is too slow. Fragmented and duplicated research in the energy materials' community inhibits its development. Innovation of advanced energy materials and a breakthrough in its effective integration into energy systems is essential to meet the needs of highly efficient and clean applications of energy production.
3. In order to integrate the research community and accelerate the rate of development of advanced energy materials, international collaboration is particularly crucial in the pre-competitive technology of advanced energy materials when focused on research, development, and demonstration of renewable energy. The following areas are recommended as collaborative areas of research and development:
 - Materials for nuclear reactors
 - Materials for thin film solar cells and solar thermal generators
 - Materials for hydrogen-energy and fuel cells
 - Materials for large-scale energy-storage technology
 - Materials for biomass energy
 - Regulations, codes and standards for novel energy materials
4. To ensure that international collaboration is effective and efficient, the financing of collaborative research and development projects and their working principles should be established under the road-map and coherent framework of the International Union of Materials Research Societies (IUMRS).

This declaration is drafted on the basis of the summary of the “Second World Materials Summit”. It captures

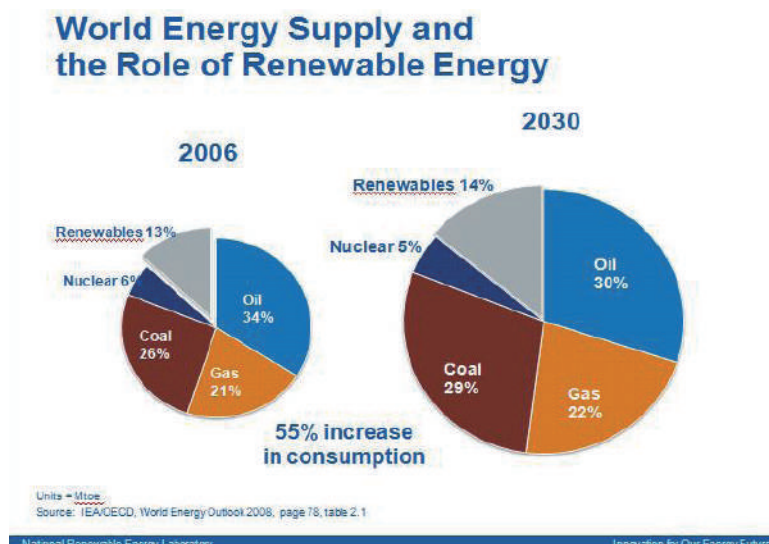


the comments and ideas that participants exchanged and summarizes the major themes that participants expressed throughout the summit. This summit was divided into five sessions, including: Solar Energy and Photovoltaic-Cell Materials, Nuclear Energy Materials, Hydrogen Energy-related Materials and Fuel Cells, Materials for Large-scale Energy-storage Technology, Materials for Biomass-energy, and Other Energy Materials. The summaries of these sessions are attached in the appendices.

5.6.4 Third World Materials Summit for Energy: a cooperative project among Materials Research Societies

After two World Materials Summits for Energy, the third one is already planned to be organized in Washington D.C. (USA) in 2011. This initiative, a cooperative project between Europe-MRS (E-MRS), China-MRS (C-MRS) and MRS, and with the support of International Union of Materials Research Societies (IUMRS), was born on an evening boat tour on a lake close to Suzhou (China) in 2005. Professor Lian Zhou, president at that time of IUMRS, leaded several discussions during some meetings in Ningbo and Shanghai with the various members societies about the future possible developments of the Internationals Materials Community. That evening on that boat it emerged the suggestion of organizing conferences on the role of materials for future energy supply. Although Professor Zhou could not bring this concept to fruition, recognition of the strategic importance of materials for the future energy worldwide supply, led to E-MRS deciding to begin the organization of the First World Materials Summit for Energy, with the support of the newly elected President of IUMRS, Professor Gabriel Crean. The inaugural summit was held in Lisbon (Portugal) on 4-5th October 2007, coinciding with the Portuguese Presidency of the European Union.

The World Materials Summit for Energy was not conceived as another conventional scientific conference, but as an event to bring together about 100 invited selected word wide leaders in science, technology and policy, representing industry, university and government, to formulate an objective view on the world's economically viable possibilities to reduce CO₂ emissions during energy production and use, by means of new and innovative materials and processes, including solar energy, wind power, biofuels, hydrogen fuel cells, and nuclear fission and fusion. Current projections estimate that the energy needs of the world will more than double by the year 2050, some demands that cannot be met by existing technologies. In this context, advanced materials, materials research and innovation are probably the most important elements to develop the required new technologies needed for this purpose.

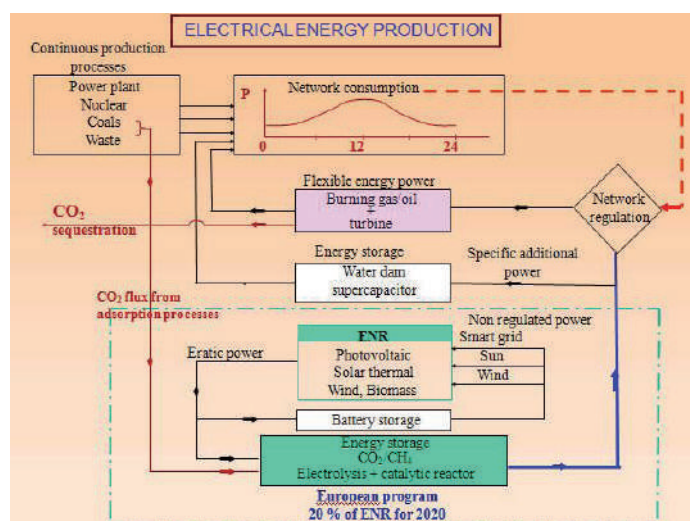


International Energy Agency (IEA) projects for energy from 2006 to 2030 (Courtesy of Dr. D.E. Arvizu from the National Renewable Energy Laboratory, Golden, Colorado, USA).

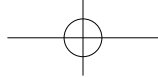
At the end of the First Summit, the most important aspects identified were published as the Lisbon 2007 Declaration on International Cooperation in Materials Research: Key to Meeting Energy Needs and Addressing Climate

Change. The meeting concluded that the present pace of research and development was too slow to meet the needs of world's rapidly growing and increasingly energy-hungry population. Effort was too fragmented, and competition between different laboratories and institutions hindered progress on complex problems where international cooperation was vital to achieve breakthroughs. It was recognized that each of the technologies discussed required new and improved materials to increase efficiency and reliability, decrease greenhouse gas emissions, reduce capital costs, and extend operating lifetimes. The conclusions were sometimes in conflict with the views expressed by the voices of main media, since it was recognized that energy coming from fossil fuels will continue to dominate for the next decades, or that hydrogen fuelled cars are far from readiness for the mass market at economically valid conditions, and that electric cars will be limited for a long time to small niche markets as Li-battery stability has to be proven and its availability in sufficient quantities to meet the demand is a major concern. It was established that only solar, further controlled use of nuclear and, at long term bio-energy are eligible for low CO₂ emissions.

The very positive output from the first Summit immediately led to the suggestions for continuing the initiative that was decided to take place in China, in Suzhou where all this idea began. The Second World Materials Summit for Energy was organized by C-MTS and The Chinese Academy of Technology on 12-15th October 2009. The Second Summit made recommendations on how to best achieve the essential acceleration of development by the worldwide materials science and technology community, and developed a declaration to be presented at the United Nations Climate Change Conference in Copenhagen in December 2009. It was concluded that safe nuclear energy is undoubtedly needed in the future energy mix, but it requires reliability and inspectability. Some of the most important challenges in this field are related with fuel cycle issues: new fuels using minor actinides are required with a reprocessing that guarantees security, low volume, and low toxicity. Also, public acceptance of this kind of energy is crucial. The experts agreed that fusion is still an exciting future, where one long lead time priority is first-wall materials. Another important issue was to start to consider CO₂ as a raw material which can be recycled into a chemical fuel. The conclusions also included the necessity for an exponential development of solar energy to the terawatt level. However, the increase in the importance of renewable energy will need totally new concepts to ensure the stability of the electrical transmission grid system. Some of these technologies are approaching grid parity (producing power at the same cost as base load power), but it is not yet clear if they can scale to significant levels based on materials, processes and devices. It was also concluded that sustained societal adoption of these emerging technologies requires educating the public and gaining its support. A clear and easily understood case needs to be made to the public for why clean, renewable, and sustainable energy is a viable and economical option, but it is also important that while the market may initially be stimulated by incentives or tariffs ultimately it will need to be sustainable.



Prospect for electrical energy production. (Courtesy of Prof. J. Amouroux, École Nationale Supérieure de Chimie de Paris (ENSCP), France)



International Union of
Materials Research Society (IUMRS)

There are significant technical questions related to efficient energy storage that should be addressed in order to determine a viable approach and its integration with the energy source and on the grid. It was conveyed that fuel cells is the cleanest and most efficient way of converting chemical energy directly into electrical energy without combustion. Among the possible energy carriers, hydrogen is ideal, owing to its energy density, for storage and mobile applications in an economy based on renewable energy provided that further developments occur. However, we will need to face several challenges for hydrogen production, such as achieving efficient separation and purification of hydrogen, improving catalysts for the water gas shift reaction that is the present dominant method, improving efficiency for hydrogen production from coal and hydrocarbons, improving the quality and stability of the materials used in water splitting, or decreasing the cost of hydrogen production. It will be also necessary to increase the storage density of hydrogen for mobile applications, increase the efficiency of hydrogen storage and release, alleviate the safety concerns with hydrogen storage, handling, and delivery, construct an infrastructure for hydrogen delivery, and establish international codes and standards for hydrogen storage and delivery. From another side, lithium ion batteries (LiB) represent an efficient solution for CO₂ abatement in the transportation sector. However, to ensure full safety of LiBs, the next frontiers to be released are improvement in the electrolyte (conductivity, temperature of operation, flammability...) and replacement of the graphite electrode by silicon, and latter copper by aluminium, which implies negative electrode materials with high capacity in the $\square 500$ mV operating range. Finally, it was clear that bio-energy is a renewable and sustainable energy, with energy cost competitive with fossil sources, and that include environmental cost/compatibility. However, the treatment of cellulose materials is expensive, and efficiency for fermentation has to be increased. It was agreed that it is necessary to establish a balance between food, fuel and other land uses, since economic biomass crops should not compromise food supply. The Second World Materials Summit provided an avenue to create international cooperation to address energy-related materials solutions, traking as priorities the relevant sections of the Kyoto resolution about the climate change. New concepts, closer collaboration between fundamental research and industry, a new and sustained international interdisciplinary materials research collaboration, but also, much closer collaboration between all the countries of world are necessary for this finality. The Summit also proposed to promote the education of a new generation of international scientists, engineers and leaders for leveraging materials science and technology for energy research and development and to provide a clear picture of the challenge, opportunities and career path.

Future Summits will be organized by E-MRS, C-MRS and MRS and held every two years, so the Third World Materials Summit for Energy is approaching at Washington D.C. in 2011.