Sino-EU International Workshop, Weihai (China)

The First Sino-EU International Workshop on Membrane Technology was held in Weihai (China) on October 13-15, 2008. European and Chinese experts coming from the academic and industrial world gave lectures in the field of membranes for wastewater treatment, fouling phenomena, membranes in agro-food and pharmaceutical industry. The Workshop was supported by the Chinese Ministry of Science and Technology (MOST), Shandong Provincial Department of Science and Technology, Weihai Science and Technology Exchange Center with Foreign Countries and the Harbin Institute of Technology, in collaboration with the Institute on Membrane Technology and the European Membrane Society. ITM-CNR and the Shandong University organized the event.

One of its major objectives was to endorse the development of membrane science and technology and its application at industrial level, but also to promote international cooperation and scientific exchanges between the Chinese and European academic and industrial institutions.

As an immediate fallout, it was agreed to organize a second Sino-EU International Workshop in 2009 or 2010; to promote the research mobility between China and Europe in the field of membrane science and technology; and to promote the participation of Chinese institutions in projects sponsored by the European Union.

Sino-European Membrane Science and Technology Center, Weihai (China)

In occasion of the Sino-EU International Workshop on Membrane Technology the Sino-European Membrane Science and Technology Center has been founded with the sponsorship of the Chinese Ministry of Science and Technology (MOST). Prof. Enrico Drioli from ITM-CNR and the University of Calabria and Prof. Guibai Li from the Harbin Institute of Technology have been appointed to serve as consultants. Prof. Janchen Ma has been indicated as Director and Professors Zhong Xu, Jun Ma and Jie Yao as vice directors.

The Centre will be a platform for Sino-European cooperation in membrane development and industrial application and for the exchange of information on topics of common interest.

Arrivederci Sulaiman!

My name is Sulaiman AL-OBAIDANI. I am from the Sultanate of Oman. I have got a scholarship from the Middle East Desalination Research Centre (MEDRC) to do my Ph.D. in the desalination field in the Institution of Membrane Technology in (Italy) under the supervision of Prof. Enrico DRIOLI. The title of the Ph.D. project was “Process Intensification: Integrated Membrane Operations for Brackish and Seawater Desalination”. The primary objective of this projects is to combine the conventional pressure-driven membranes with the membrane contactors technology in order to redesign the desalination process and increase it’s performance, improve water quality, reduce water costs and maintain sustainability by reducing the environmental impact due to brine disposal.

During my work in the Ph.D. project we assembled a semi-pilot plant of the integrated membrane system and we conducted many tests using synthetic and real seawater. This plant was designed based on the results obtained by simulation and preliminary experiments conducted during the early stages of the project.

I spent here in the Institute more than three years and recently I defended my Ph.D. thesis. These three years were very fruitful and I had a good chance for learning and widening my knowledge besides the practical experience gained during the study period. The environment here is very friendly and encouraging for doing scientific research at high levels. There was also very good opportunity to contact many people from different international institutions and organizations who are working in similar fields and exchange our knowledge through the international meetings and conferences organized by the Institute.

Finally, I would recommend any researcher or graduate students who are seeking for superior education, practical experience and the skill to conduct scientific research to join the Institute and take the opportunity to be a member of the research group.


Visiting Scientists  (June 2008 - Dec. 2008)

**Dr. Rafiqul Islam** of the Dept of Applied Chemistry & Chemical Technology, University of Dhaka, Bangladesh, is spending 3 months, from September 1st, 2008 to November 30th, 2008, at ITM-CNR as a visiting Scientist-Professor. Dr. Islam is carrying out some research work on the preparation of membranes that can be used in water treatment, especially for arsenic mitigation, which is of vital importance for his home country Bangladesh. Professor Islam also works on CO₂ emission reduction and CO₂ conversion and management, another research area of global importance. He plans to work in this area too, utilizing membrane, if not this time due to lack of time then in near future in a collaborative research program.

Dr. Rafiqul Islam availed many prestigious Post-Doctoral Fellowships like Marie Curie Bursary by the Commission of the European Communities, UNESCO Fellowship, Alexander von Humboldt Fellowship, Commonwealth Academic Staff Fellowship. Dr. Islam was the Winner in the Olympiad of Young Scientists held in Moscow. He is an Executive Committee Member of many National Committees in Bangladesh, Organizing Secretary of the Bangladesh Chemical Society and the Vice-Chairman of the International Chemical Congress Bangladesh 2008.

Professor Islam made more than 50 publications in national & international journals on Energy & Environment.

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**Said Bey**, from the BEJAIA University- Algeria, will spend 18 months at the ITM-CNR for conducting experiments for finalizing his PhD Thesis in Chemical Engineering on: Preparation and Characterization of Modified Liquid Membranes: Studies and Applications. His research activities will be mainly devoted to:

- Preparation (phase inversion process) and characterization (water permeability, contact angle, SEM pictures, DSC, ATG/ATD, porosity) of hollow fibers membranes based on PEEKWC polymer.
- Application to the extraction of arsenite (As(III)) and arsenate (As(V)) by hollow fibers membranes contactor and polymer inclusion membranes.

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**Eun Woo LEE**

I have been working in KRICT (Korea Research Institute of Chemical Technology) for three and half years as a research engineer. In KRICT, main research topic was gas and vapor permeation using polymeric membrane. Just two months later my husband (Seung-Hak CHOI) starts his post-doc research in ITM-CNR, I also started my research career at the same place. It is really good chance for me to research new area, meet new people and share ideas.

In ITM, my research topics are two different things. One is preparation and characterization the catalytic membrane reactor. The other is membrane crystallization.

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**Seung-Hak CHOI**

I completed my Ph. D. in Green Chemistry and Environmental Biotechnology at Korea University of Science and Technology in February 2008. My Ph. D. research focuses on the preparation and characterization of polymeric hollow fiber membranes for the separation of gases and vapors from permanent gas mixture. During the Ph. D., I was involved in several projects sponsored by Korean government. These projects were very valuable for me to understand the preparation of membranes, modules, design the membrane process, operate it, and evaluation the whole process.

Just after I finished the thesis, I started my very first career in industrial company named, SepraTek Inc. recent years in the company were devoted to projects in dehydration of organic solvents by using a pervaporation process and development of degassing polypropylene (PP) membrane by TIPS (Thermally Induced Phase Separation) process.

I have been trained as postdoctoral research fellow at ITM-CNR since the 1st of March 2008. In ITM-CNR, my research focused on the preparation and characterization of membrane reactors and numerical simulation the process. As time goes by, I realize what I need to learn and know who can fill my drawback. I am very sure that experience in ITM-CNR is going to provide excellent opportunities for my careers.

Finally, living in abroad is not easy-different language, different custom, different thinking- but I like, actually, I love Italian people and the beautiful food. God blessed the Italian food. All the researchers in ITM are absolutely fantastic.

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**Simon CHOVAU**

In the last year of my studies in chemical engineering, I choose the specialty “environmental technology” and got fascinated by water and air treatment. Because I liked the idea of doing my thesis in a foreign country I asked my professor Dr. Ir. Bart Van der Bruggen if this was possible. He said that it was possible in the Erasmus framework at University of Calabria in Italy under the supervision of Dr. Figoli and Prof. Drioli. That is how I came here at the ITM-CNR.

My thesis is based on an important environmental aspect, namely the removal of VOC's from water by membrane technology. The technique used is pervaporation. The experimental part refers to tests of different types of membranes made either in Belgium either at ITM-CNR. In particular, the SBS membranes prepared at ITM-CNR should give superior results (as shown from the preliminary results) to the commercial used PDMS membranes.

For me it is a very interesting subject and I am glad to be here.

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**Sudip CHAKRABORTY**

I have already passed a significant seven months here in ITM-CNR for my doctoral research activity but I never realized that I am far away from my family. I feel everybody here is close to my heart and I am getting a homely environment here. It is a home away from my home. In fact, the life of a PhD student is daunting: loneliness, pressure, isolation, and boredom are always close at hand. Nevertheless, I felt very happy when I was doing my research and I also enjoying every part of it. All the people here are always supportive of me and provide their best efforts for me.

Not only I am doing my research here at ITM-CNR, but also I am actively participating to the activities like trekking, hiking with Lidia, Mariella in the footprint of CAL. In the field of my research I am trying to reach my goals to make an Integrated Membrane Processes by application of Membrane bioreactor for Innovative production Systems. It might be achieved by introducing advance membrane separation operation in the whole production systems in the logic of Process Intensification.

Thank you Prof. Drioli for giving me a chance to work with you in such a world class Institute and provide me all the support.

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**Zeynep Çamaş** from the Faculty of Engineering and Natural Sciences, Sabanci University, Istanbul (Turkey) carried out a summer internship on “Material Science” from July 26th Sept. 6th, 2008.
My name is Agnieszka Anna Leopold. I'm Polish but I live in Barcelona, Spain, where I do a PhD studies in the research line of the Chemical Engineering Processes at the Universitat Politècnica de Catalunya (UPC). I work in the field of extraction of heavy metals by application of supported liquid membranes and membrane contactors. During my stay at the ITM-CNR, having Dr. Alessandra Criscuoli and Dr. Alberto Figoli as supervisors of my experimental work, I’d like to investigate thoroughly the performance of the processes that employ membrane contactor technology, focusing on the membrane-based extraction of arsenic(V) from neutral and acidic aqueous medium by the laboratory version of hollow fiber membrane contactors. Two types of hydrophobic hollow fibers, the commercial ones and the ones prepared on the laboratory scale at ITM-CNR, will be tested. Different commercial extractants will be also investigated in order to compare their extraction efficiency.

Ji Xiaosheng from the Development Center of Water Treatment Technology, Hangzhou (China), is carrying out a PhD Research in the following areas:
- fouling and fouling control of membrane distillation by applying an appropriate pretreatment such as Ultrafiltration (UF), MBR;
- investigation of the scaling phenomena occurring in MD operated on seawater brine: effect of the membrane properties;
- study of the salts crystallization kinetics in presence of organic contaminants.

**ITM Researchers abroad (June 2008 - Dec. 2008)**

Within the framework of the High Training for Researchers from Universities and Public Research Institutes of Calabria, sponsored by Calabria Institutions (Azione 3.7.b “Incentivi alle persone” POR FSE CALABRIA 2007/2013), Dr. Annarosa Gugliuzza carried out an excellence stage, from Nov. 1 to Nov 30, 2008, at the Chemical Engineering Department of the University of Michigan in Ann Arbor MI, USA. Her study focused on the deepening of new and advanced techniques for the creation of next generation functional membranes. Investigations through technologically sophisticated instruments have led to important results in short time, promoting new collaborative research.

From Oct. 8 to Oct. 22, 2008, Dr. Elena Tocci visited the Soft Condensed Matter Group at Leiden Institute of Chemistry, Leiden University (The Netherlands) in the framework of the CNR Short-term Mobility Programme 2008 with the aim of promoting a scientific collaboration between the ITM-CNR Modeling Group and the Soft Matter Chemistry laboratory in the area of mesoscale modeling in polymeric membranes. In particular, the attention has been focused on the investigation of morphological/physical and mechanical properties of polymeric blends of material with innovative properties. In the field of applied soft-condensed matter physics, mesoscopic dynamics models are receiving increased attention as they form a bridge between fast molecular kinetics and slow thermodynamic relaxations of macroscopic properties. The topic is of considerable importance for the understanding of many types of industrial complex liquids. The Soft Condensed Matter Group is headed by Prof. Hans Fraaije, who has been a pioneer in two EU-granted projects (Caesar and MesoDyn) which resulted in the development of the MesoDyn method a unique software of morphology prediction in complex polymeric fluids.

From Oct. 9 to Oct. 12, 2008, Dr. Alfredo Cassano visited the Citrus Research Institute in Beibei (Chongqing, China) as coordinator of the Joint Project "Upgrading fruits and vegetables juice quality and enhancing by-products utilization through integrated membrane processes" carried on in the framework of the 2008-2010 Bilateral Agreement between CNR and CAAS (Chinese Academy of Agricultural Science). During the visit the application of membrane systems in the agro-food sector have been further investigated focusing the attention moreover on the production of concentrated fruit and vegetable juices by integrated membrane processes. The Fruit Juice Processing Labs of the Citrus Research Institute Labs are equipped with plants for the extraction of citrus juices from their fruits and thermal evaporators for the juice concentration. In addition, membrane pilot plants for osmotic distillation, reverse osmosis and ultrafiltration processes are in operation. During the visit some topics of common interest were discussed and evaluated for further development at experimental level. In particular, they can be summarised as follows:
1. separation and recovery of by-products with high added value from wastewaters of agro-food industries;
2. integrated membrane operations for the production of fruit juices with high nutritional profile;
3. extraction and purification of nobiletin from by-products of the citrus industry;
4. integrated membrane processes for developing new formulations containing substances with nutritional and pharmacological interest (nutraceuticals);
5. nanofiltration processes for colour removing from fruit juices.

Dr. Alfredo Cassano has also given a seminar at the Southwest University in Beibei entitled “Integrated membrane processes in fruit juice processing” where he presented the main results obtained in the clarification and concentration of fruit and vegetables juices by using membrane operations.

On October 17 2008, Lidietta Giorno was awarded the certificate of Visiting Professor at the Tianjin University of Science and Technology, China (http://news.tust.edu.cn/xfrw/). Her scientific interaction with the Department of Biochemical Engineering of the TUST focused on engineering of membrane assisted biocconversions and separations for innovative production strategies in food, biotechnology, pharmaceutical and traditional Chinese medicine, able to prevent and minimize waste materials.

The cooperation aims at both research development and education in membrane bioengineering. During the event, Lidietta Giorno gave a lecture on “Enzyme Membrane Reactors and Membrane Emulsification in the Pharmaceutical and Biotechnology Industry” and discussed about the state of the art and future perspectives for membrane technology to promote innovative strategies for sustainable production.
Dr. Loredana De Bartolo and Dr. Franco Tasselli have been invited by Prof. Gabor Forgacs at the Departments of Physics, Biology and Biomedical Engineering of the University of Missouri Columbia (USA), in the framework of a research collaboration aimed at the development of bioartificial constructs.

Dr. Loredana De Bartolo gave an invited lecture on “Membrane systems in Regenerative Medicine and Tissue Engineering” on 5 November 2008.

Also, the ITM researchers participated in collaborative experiments in order to develop a tissue engineered construct using tailored hollow fiber membranes prepared in ITM laboratories. Preliminary results have been promising and encouraging for the continuation of this common project.

PROJECTS MEETINGS AND RELATED ACTIVITIES

NanoMemPro: Practical demonstration within WP10, Rende (Italy)

On 23 and 24 June 2008 a demonstration of “Production and use of porous hydrophobic membranes for application as membrane contactors” was organized in the framework of NanoMemPro’s Workpackage 10 on Back-Design and Mass Production of Membrane Materials. This demonstration was one of the activities planned on the following four different fields (leading laboratory between parentheses):

- Membrane Contactors (ITM-CNR)
- Membrane Separations in Non-Aqueous Systems (Imperial).
- Membranes for Pure and Applied Gas Separation (U-Twente).
- Membranes for low and high temperature fuel cells (GKSS).

All NanoMemPro members and the members of the Club of Interest have been invited for this event. The two-day demonstration took place at the ITM-CNR laboratories in Rende (Italy) in a very informal and cordial atmosphere. Besides the NanoMemPro members, also some international visitors of ITM-CNR have participated to the meeting.

The meeting was set up with first a general introduction on membrane preparation, use and requirements, followed by practical demonstrations in the laboratory, where all relevant aspects were illustrated and discussed. The laboratory demonstrations were alternated with several powerpoint presentations.

NanoMemPro: European Master on “Membrane Engineering”, Enschede (NL)

The representatives of the nine Education Institutions involved in the creation of an Erasmus Mundus European Master on “Membrane Engineering” under the umbrella of NanoMemPro gathered for a meeting at the University of Twente on November 4th.

In details, the partner Universities from seven different European countries are: the “Université Paul Sabatier” in Toulouse (France), the Institute of Chemical Technology in Prague (Czech Republic), the “Universidad de Zaragoza” (Spain), the “Universiteit Twente” (The Netherlands), the “Univesidade Nova de Lisboa” (Portugal), the “Università della Calabria” in cooperation with the “Institute on Membrane Technology ITM-CNR” (Italy), the “Katholieke Universiteit Leuven” (Belgium), the “Université Montpellier 2” (France) and the Technical University of Denmark (Denmark).

Devoted to non-EU students having a Bachelor in Chemical Engineering, Materials Science or Physical-Chemistry, the Master proposal is structured in four semesters: the first one devoted to Fundamental of Material Science or Chemical Engineering (studies to be completed in the French Universities), the second one devoted to Fundamentals of Technologies and Modeling Aspects (in Prague), the third one more focused on Membrane Science and Technology to be completed in one of the following three countries: Nanotechnologies & Biodevices (Spain), Energy & Environment (The Netherlands), Biotecnologies, Food & Health (Portugal). The closing semester will be spent in the laboratories of one of the proposal partners in order to finalize the Master Thesis.

NanoMemPro: 4th Annual Meeting, Brussels (Belgium)

The Fourth Annual NanoMemPro Meeting was held in Brussels (Belgium) on 6th and 7th November 2008. Scope of the meeting was to present all the research activities carried out by the various partners during this last year.

In this framework, Dr. Lidietta Giorno presented the activities of the Workpackage she is leading: WP11.2 – Food Quality: Safer Production Methods. Dr. Giorno illustrated the objectives of the WP11.2 which resulted to be in line with those initially indicated.

In particular, for this period, the specific objectives were:

- To continue the assessment of the various membrane operations in food application.
- To identify case studies of industrial interest and plan common actions to proof the processes robustness by building-up demonstration plants and running long term experiments.
- To organize a workshop with Col and CoE to set the state of the art and perspectives.
- To disseminate the food road-map.
- To rationalize activities through SBRA (European Membrane Strategic and Business Research Agenda).

... http://www.nanomempro.com/
NAPOLYNET: Kick-off Meeting, Rome (Italy)

On May 15-16, 2008, the kick-off and General Assembly meeting of NaPolyNet was held at the coordinating institution, CNR in Rome. All project partners except the team from the SciTe (The Netherlands) attended this meeting, which was also supported by the presence of the responsible project officer of the EC, Dr. Soren Bowadt and of the legal officer of the EC Dr. Christian Probst.

The project coordinator, Dr. Clara Silvestre gave an overview on the work hypothesis and objectives as well as on the organization of the project, which is structured in seven work packages, the distribution of work between the partners, the timetable of the planned activities and the expected output. The workpackage leaders presented their activities in details… [http://www.napolynet.eu]

MEDIIRAS: Kick-off Meeting, Freiburg (Germany)

The kick-off meeting of the three years project: Membrane Distillation in Remote Areas (MEDIIRAS), funded by the European Commission within FP7, was held on October 28-29 2008, at the Fraunhofer ISE in Freiburg (Germany).

The project is addressed to the development of solar thermally driven membrane distillation systems to be used both on coastal and inland sites. The Countries participant to the project are Germany, Italy, Tunisia, Belgium and Spain. Main tasks for ITM-CNR are the development of brine disposal units and brine cooler and the design of membrane distillation units. Dr. Ing. Alessandra Criscuoli is the scientific responsible of the project for ITM-CNR.

IMEI: Kick-off Meeting, London (UK)

The Kick-off Meeting for the research Project “Implementation of Membrane Technology to Industry (IMETI)” was held on 8th July 2008 at the Imperial College, London (UK). The project, funded under the EU-FP7 in the Research area: PEOPLE-2007-3-1-IAPP Marie Curie Action: “Industry-Academia Partnerships and Pathways”, gathers six different partners coming from Italy, UK, Bulgaria, France and The Netherlands.

During the meeting each partner delivered a brief presentation of its research activity and topics of interest. The First year plan of activities was also presented, describing in more details work packages and objectives of the project, description of work, deliverables and researchers involved for each work package. In addition, the recruitment strategy was illustrated.

MEDINA: 2nd Annual Meeting, Sede-Boker (Israel)

Within the 6th Framework Program of the European Commission, Membrane-Based Desalination: An Integrated Approach (acronym MEDINA) is one of the funded research project. Its main aim is to improve the overall performance of membrane-based water desalination processes by applying an innovative approach based on the integration of different membrane operations in the reverse osmosis (RO) pre-treatment and post-treatment stages accordingly to the philosophy of Process Intensification.

In the pre-treatment steps, the integration of different tools (such as water quality characterisation, membrane cleaning strategies, selection of the most appropriate pre-treatment processes) leads to the minimisation of membrane replacement needs, thereby reducing the operating costs. In the RO post-treatment stages, the presence of Membrane Contactors (MC) and/or Membrane Distillation (MD) and/or Membrane Crystallizer (MCr) and/or Wind Intensified Enhanced Evaporation (WAIV) working on the brine streams offers the possibility to produce more fresh water thus increasing water recovery factor of current desalination plants, reducing brine disposal problem and approaching the concept of “zero-liquid-discharge”, “total raw materials utilization” and “low energy consumption”.

The project started formally on Oct. 15th 2006 and it had its Second Annual Meeting in the Negev Desert (Israel), where the project teams presented the main results achieved in the first two years of research activities. In particular, various analytical protocols and surrogate bench-scale tests to quantify the quality of pre-treated water prior to application of RO in terms of fouling potential with respect to particulate/colloidal fouling, natural organic matter (NOM) fouling, biological fouling (biofouling) and inorganic fouling or scaling have been developed and compared; membrane autopsies for understanding fouling causes on RO membranes used for sea or brackish water desalination have been performed; different membrane chemical cleaning strategies based on the nature of fouling have been compared and optimized; different pre-treatment methods such as MF, UF, MBR, NF, PAC adsorption and ferric chloride (FeCl3) flocculation were evaluated in terms of their capability in removing seawater organic matter and the characteristics of the foulants on the seawater reverse osmosis (SWRO) membranes; several microporous hydrophobic membranes for membrane distillation systems have been prepared and characterized; a software to describe and simulate VMD (Vacuum Membrane Distillation) for high salt concentrations has been developed; results on the performance of membrane crystallization and wind intensified enhanced evaporation for reducing the volume of concentrates and recovering the dissolved solid salts in the form of high-purity crystals have been presented; different experimental solar systems (cylindro-paraboloid concentrator, vacuum multi-tubes captor) that could be further used to design membrane solar captors have been realised; the requirements of an EIA (Environmental Impact Assessments) study for membrane desalination plants have been investigated, starting from existing general EIA frameworks and manuals, which have been adjusted to membrane desalination plants; the analysis of the relevant impact of membrane desalination plants is in progress.

At the moment twenty-six deliverables have been already by the project partners and are available on MEDINA web-site (http://medina.unical.it). MEDINA project is scheduled for 12 more months, when the results achieved in the RO pre-treatment and post-treatment stages will be incorporated in an integrated membrane-based desalination system in order to analyse how the simple and the overall performance will change because of the synergetic interaction.

PROMEMBRANE: Final Meeting, Cetraro (Italy)

ITM – CNR organized the final meeting of ProMembrane project, funded by the European Commission within FP6 (duration of the project: August 2006-August 2008). The meeting was held on July 20-21 2008 at Hotel San Michele, Cetraro (CS). During the meeting the different activities carried out in the two years of project were summarized and last deliverables presented. As fallout of the project, several opportunities to continue the cooperation among partners were discussed. A visit at ITM – CNR facilities was also organized. Prof. Enrico Drioli, Dr. Ing. Alessandra Criscuoli and Dr. Alberto Figoli of ITM – CNR are involved in the project.

…[http://www.promembrane.info]
### NanoGLOWA: 2nd Annual Meeting

The most currently used technology for CO\(_2\) capture and separation is via absorption that requires huge energy consumption and installations costs. The application of nanostructured membranes for CO\(_2\) capture and separation brings down the energy penalty and installation demands. In this logic, NANOGLowa project, funded by the European Commission (EC) under the 6th Framework Programme, brings together universities, power plant operators, industry and SMEs. 26 organisations from 14 countries throughout Europe join the NANOGLowa-consortium for developing optimal nanostructured membranes and installations for CO\(_2\) capture from power plants.

The ITM-CNR has the responsibility of the “central testing laboratory” of the membranes prepared by other partners devoted to the membrane development. The project is going on and, at the end of October, has been held in Aachen (Germany), the second year meeting to which participated the main part of the partners. This meeting was mainly focused on the improvements obtained by the membrane producers (WP1-WP5) in terms of permeance and selectivity of the membranes with respect to the imposed target of a permeance higher than 0.1 m\(^3\)/m\(^2\)h bar and a selectivity higher than 150. Furthermore, some preliminary simulation results for the integration of these membrane in power plant stations were proposed by some other partners. The activities for the next 6 months were also decided. The ITM-CNR will continue the testing on several membrane supplied by the WP1-WP5 and it will also focus the activity on a modelling/simulation phase with which will analyzes the single or multi- membrane stages performance on CO\(_2\) removal from flue gas streams.

### CAMERE: 3rd Annual Meeting, Cetraro (Italy)

The 3rd year annual meeting of the CAMERE project (RBNE03JC5S – New catalytic membranes and membrane reactors for selective reactions as advanced system for a sustainable growth”) took place on September 4 - 5, 2008 in Cetraro (Italy). This project funded in the framework of the Investments Fund sponsored by the Ministry of Education, University and Research of Italy - MIUR aims to develop new catalytic membranes and catalytic membrane reactors for selective reactions as advanced systems for an industrial sustainable development in the logic of the process intensification strategy.

The project activities, developed with the strong cooperation of all the partners, six different Italian Universities and Research Centres (with ITM-CNR acting as the coordinator), concern the catalytic membrane preparation, the catalytic activity evaluation and the modelling/simulation of the studied reactions. The project is expected to start in the first half of 2009 and the planned duration is three years.

### NEW RESEARCH PROJECTS

An FP7 project entitled “Nanocomposites and Nanostructured Polymeric Membranes for Gas and Vapour Separations (DoubleNanoMem)” has recently been approved. The project will be funded under the Seventh Framework Programme as a Small or Medium-Scale Focused Research Project in the Area “Mastering Nanoscale Complexity in Material”. It involves eight different research teams and two enterprises from Italy, the United Kingdom, The Netherlands, Belgium, the Russian Federation and the Czech Republic and will be coordinated by ITM-CNR with Dr. John Jansen as coordinator.

The project will focus on the combination of specialty polymers with high free volume or intrinsic microporosity and well-defined nanofillers as novel membrane materials with increased permeability and selectivity. The application fields aimed at are natural gas treatment, CO\(_2\) separation from flue gas and bioethanol production. The experimental work will be supported by detailed modelling studies of the behaviour of the penetrant molecules and the membrane matrix. The project is expected to start in the first half of 2009 and the planned duration is three years.

Sabrina Morelli, researcher at ITM-CNR, is the Scientific Responsible of a research on “Study of IL-6 effect on the expression of membrane receptors and transduction of signal in human hepatocytes in a membrane biohybrid system” in the Framework of a Research Project just approved by the Ministry of Education, University and Research of Italy (PRIN - Research Programs of National Relevance).

The Project entitled: Study of the molecular mechanism involved in the cardiovascular mortality and morbidity of patients in haemodialytic treatment by membrane biohybrid systems started on Sept. 22 and will for a period of 2 years.

### Masters, PhDs, Trainings performed at ITM - CNR laboratories

In the framework of the collaboration with the University of Calabria, the ITM-CNR laboratories accommodate students for performing research related to their master and PhD theses and training activities. The following PhD students of the Doctorate in Chemical Engineering and Materials completed on Nov. 2008 their studies and defended their theses for the XXI Cycle.

- Sulaiman Al-Obaidani, An Integrated Membrane Operation in Desalination of Sea and Brackish water
- Maria Rende, Engineering membrane biohybrid system for hippocampal neuronal cells culture
- Francesca Macedonio, Membrane contactors for water purification and recovery factor increase in desalination plants
- Alessio Caravella, Modeling of PD-based membrane reactors for hydrogen purification and production from methane steam reforming

### MISCELLANEOUS

On Nov. 6th and 7th, 2008, a Seminar on “Marketing of innovation and technology transfer services” was organized by the Italian Network for Innovation and Technology Transfer to SMEs (RIDITT) at the University of Calabria. The initiative is promoted by the Italian Ministry of Economic Development and managed by the Italian Institute for Industrial Promotion (IPI). ITM-CNR was requested to collaborate to this event. In the afternoon of Nov. 6th the participants to the Seminar visited the ITM-CNR laboratories and discussed the various activities of industrial interest in progress.

Lidietta Giorno has been appointed by Elsevier as Subject Editor for the Scirus Topic Page (http://topics.scirus.com/) on Chemical Engineering.

Scirus Topic pages:
- Is a free service that serves authoritative topic summaries
- Is introduced by scientific experts
- Facilitates knowledge sharing
- Provides the latest and most relevant journal and web results
Membrane-based operations for the clarification and concentration of fruit juices

The application of membrane processes to the clarification and concentration of fruit and vegetable juices has been extensively studied during the last years at the Institute of Membrane Technology (ITM) of the Italian National Research Council (CNR). Integrated membrane processes have been developed for different types of fruit and vegetable juices such as citrus (red and blond orange, bergamot, mandarin, lemon), kiwifruit, carrot, apple, cactus-pear and pomegranate juices. Experimental results confirm the possibility to obtain concentrated fruit juices characterised by high nutritional and organoleptic properties, with a final total soluble solids (TSS) content of 65-70 °Brix. The new membrane-based process for the concentration of fruit juices is very efficient in preserving the antioxidant activity (TAA) of the final product, even at high concentration: analyses of antioxidant compounds (flavonoids, anthocyanins, ascorbic acid, hydroxycinnamic acids, betalains, etc.) in concentrated juices reveals that these compounds are well preserved during the treatment (Figure 2), since membrane operations are athermal and do not involve phase changes or chemical additives. Nevertheless, concentrated juices retain their pleasant aroma, which is on the contrary completely lost during thermal treatment. Concentrated juices can be used in foods and nutritional supplement formulations or as a source for colouring foodstuff. They can be also added to the water and to the retentate coming from the clarification step for the preparation of fibre enriched beverages. The proposed processes permit to preserve the nutraceutical and functional importance of the processed fruit juices in comparison with the traditional clarification and concentration procedures.

Method for fabrication of elastomeric asymmetric membranes for VOCs recovery from waste water by pervaporation

The Institute of Membrane Technology (ITM-CNR), in cooperation with Environmental Protection Agency of United States USEPA of Cincinnati (USA) has been successfully involved in the preparation of novel elastomeric asymmetric styrene-butadiene-co-styrene (SBS) membranes for improving the performance of the existing pervaporation membranes for volatile organic compounds (VOCs) recovery from waste water. It has been widely proven that pervaporation (PV) technology can compete with other separation or extraction processes and it has already provided very good answers in environmental problems. The work performed by Dr. A. Figoli and Prof. E. Drioli (ITM-CNR) in collaboration with Dr. S. Sikdar (USEPA) led to a US patent, published in May 2008 [1]. Pervaporation is a process for the effective separation of volatile organic chemicals, or VOC's, from water. This process provides a cost effective means to achieve the removal of VOC's in the 50 to 150's ppm range and up by concentrating a factor of 10 to 7000 times or more, permitting recovery in a concentrated form by phase separation for recycle and reuse or disposal. The economic application of pervaporation is highly dependent upon the efficiencies of the membranes developed for pervaporation applications. The commercial pervaporation membranes are “composite” type, made by two different polymers which have different functions: one is used as support and the other represents the active thin layer which is responsible of the separation of the species of interest. The novel asymmetric SBS membranes have been prepared by phase inversion technique which allows to modulate the morphology of the novel membrane with a ultra thin active layer. The actual process of phase inversion depends on a number of thermodynamic and kinetic factors, which determine the membrane morphology. Of fundamental importance is the exchange rate of solvent and nonsolvent in the cast polymeric solution. Depending on these exchange rates, membranes with symmetric or asymmetric structures are formed. Different membrane structures were obtained by using different nonsolvent-solvent pairs. The influence of several parameters on the membrane morphology, such as the composition of the polymer solution (concentration, type of solvent), composition of the coagulation bath, the exposure time before immersion in the coagulation bath, has been deeply studied. The membranes were characterised by Scanning Electron Microscopy and the cross section and surface of the made asymmetric membrane is shown in figure 1. The success of the preparation of asymmetric membranes (made by a unique polymer) will lead to a easier membrane production at lower cost. Furthermore, the SBS polymer is readily available and inexpensive, and the symmetric composite membrane already tested provides an excellent separation factor and flux. For these reasons, the commercialization of this approach is anticipated to be easily achieved.