

Editorial



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In June the CARENA project had its annual meeting at the University of Salerno, Italy. Two years into the project the outlines of what we will achieve are appearing. And, are we turning the bright plans we committed to paper 3 years ago into reality? Of course, experimenting on novel ideas, combining the technical challenging, the success rate will never be 100% on the original ideas. Nonetheless, progress on our intended goals is very good.

But, as it should be in an EU project which runs 5 years from conception to completion, luckily we do not limit ourselves to the "itinerary" of our sailing trip. If you bring together such a motivated group of scientist and engineers, new ideas are taken up and partners knowledge and knowhow of the partners is combined to set out a new course. And that is how it should be.

I enjoyed the open atmosphere at the meeting. The 45 persons present, combined 15 nationalities from 4 continents. A number I find even more impressive: over one third of the persons present is currently working outside of his or her country of origin. I am convinced this mix of nationalities and cultures contributes greatly to the openness. Crossing borders, whether national or between institution and companies, creates an open attitude towards new experiences and learning. It is a great opportunity to operate in such an environment.

By coincidence Salerno is close to a famous name sake of the project: the Punto CARENA lighthouse on the nearby island of Capri. And as with a sailing trip, for a complex project as the CARENA project you need a good map, or in our case, our description of work. You need to know the waypoints or lighthouses underway. But most importantly, you need a team which is able to handle the ship in changing circumstances. The CARENA team is just that.

What is CARENA ?

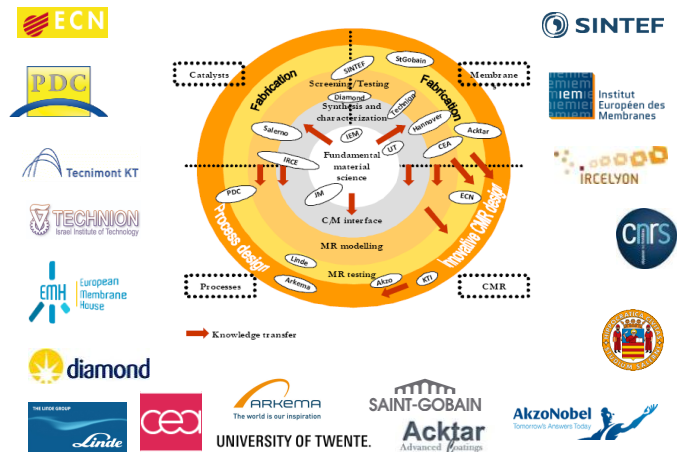
The 1st of June 2011 marked the start of the CARENA project: **Catalytic Reactors based on New Materials for C1-C4 valorization**. It is an EU-funded collaborative project to create technologies enabling efficient conversion of light alkanes and CO₂ into higher value chemicals. To reduce the dependency of the European community on imported oil, the CARENA project will promote the implementation of catalytic membrane reactors in the European chemical industry.

*Collaborative Project: Large-scale integrating project
FP7-NMP-2010-LARGE-4
48 months - Start day : 1st June 2011*

www.carenafp7.eu

The consortium

CARENA gather **19 partners** with high level of expertise in their fields all over Europe





CARENA in progress

1- Demcamer & CARENA Joint Workshop – 30 January 2013 – Eindhoven, The Netherlands.

The Demcamer & CARENA workshop on membranes and Membrane Reactors has been hosted at Eindhoven University of Technology on 30 January 2013. Around 45 people attended the meeting both working in CARENA and Demcamer projects but also external guests.

The introduction to both projects, given by the coordinators, have shown how the two consortia share similar challenges in membrane preparation and in membrane reactor configurations. Four main lectures have been given during the meeting on membrane preparation, catalyst preparation, membrane reactor application and membrane reactor modeling. The participation of several young researchers made the discussion very interesting especially during the poster session.

From the discussions during the meeting it has been proposed to repeat this event in 12-18 months by giving the opportunity to PhD students to present their work.

An idea is to also cooperate with other projects dealing with membrane reactors to have a more effective dissemination of the results. Another idea is to co-organize an exploitation workshop where we can show to industrial partners the demonstration units developed in the current projects



The DEMCMER is a Large scale collaborative project funded under FP7 Cooperation Specific Programme and Nanotechnologies, Materials and Processes NMP Theme. The Project has started the 1st of July of 2011 and it will last for 48 months. It is conducted by 18 Partners and coordinated by Tecnalia.

The aim of DEMCMER project is to develop innovative multifunctional Catalytic Membrane Reactors (CMR) based on new nano-architected catalysts and selective membranes materials to improve their performance, cost effectiveness (i.e.; reducing the number of steps) and sustainability (lower environmental impact and use of new raw materials) over four selected chemical processes ((Autothermal Reforming (ATR), Fischer-Tropsch (FTS), Water Gas Shift (WGS), and Oxidative Coupling of Methane (OCM)) for pure hydrogen, liquid hydrocarbons and ethylene production.

<http://www.demcamer.org>



2 - Review of the Current State

The annual project meeting, organized at the University of Salerno on June 4 and 5, 2013, offered an excellent opportunity to take note of the big achievements so far. Beside the presentations of the work package leaders, who gave an overview of the progress and results per work package, there were three highlight presentations focusing on the three key topics in CARENA: catalysts, membranes and membrane reactors. The first highlight presentation was given by Céline Daniel, who showed the results of catalyst screening, CSTR and characterization tests performed at IRCE-Lyon of over 50 dimethyl carbonate (DMC) catalysts prepared by Johnson Matthey. Professor Caro of Leibniz University of Hannover presented innovative membranes being developed in WP4: Hydrogen and oxygen transport membranes, which are applied in WP2, and membranes for separation of water/steam for WP3. Finally, Maria Saric of ECN presented the conclusions of the system studies for the large-scale methanol production as well as the design, construction and test results of the integrated pilot catalytic membrane reactor at ECN with a total membrane area of 1 m².

Highly appreciated by the 45 participants of the annual meeting were the 10-minute presentations by the PhDs and post-docs working in CARENA. Each of them presented very interesting results of high scientific value and importance to the progress in the project. Their work not only led to a large number of papers and (poster) presentations, which exceeds the expectations, but also to several initiatives by partners to evaluate and discuss IPR issues.

Another important aspect of the annual meeting was paving the way for the two remaining years of the project. This was for example done in separate WP meetings organized on the day before and after the meeting, but also by discussing important development topics in cross work package meetings. WP1, 2 and 4 discussed common issues and alignment of palladium membrane development and in a parallel meeting the developments in WP3 were coordinated with the tasks in the membrane, catalyst and modeling toolbox work packages 4, 5 and 6. It was very positive to see the active participation of partners in these meetings, also in discussions that went beyond their own tasks. To me, this indicates that the partners effectively work together, which is one of the key prerequisites for a successful project.

The results up to now are very promising. Together with the good spirit and collaboration between work packages and partners, I am confident that we are well prepared to deal with the scientific and technical challenges in the second half of the CARENA project.

Hank Vleeming
CARENA operational manager

CARENA

3- Interview of CARENA partner: Emma Palo from KT – Kinetics Technology SpA, Italy and Frans Van Berkel from ECN, The Netherlands.



Can you give us some background information about your education and current research?

Emma Palo: I graduated in Chemical Engineering cum laude at the University of Salerno in 2003 and I received my Ph.D. in Chemical Engineering from the University of Salerno in 2007. Further for several years I was research fellow at the University of Salerno. My research activity was mainly focused on the study and application of heterogeneous catalysis in energy and environmental fields, including the syngas production from hydrocarbons and renewable sources, syngas purification, and abatement of nitrogen oxides through selective catalytic reduction with methane, for applications in the cars engines field.

Starting from 2011 I am technology project coordinator in Technology and Business Development Department in KT - Kinetics Technology S.p.A. working with Gaetano Iaquaniello. I am involved in the project management mainly of R&D European project such as Carena and Next-GTL (both belonging to FP7 programme). In KT SpA I work on novel process scheme development for syngas production and purification, olefins production by alkanes dehydrogenation or CO₂ rich mixtures. For all these processes attention is given to the protection of intellectual property.

Frans Van Berkel: I studied chemistry at Leiden University with main emphasis on solid state chemistry. I later obtained my PhD at the same University studying ruthenium oxides, where these ruthenium oxides were used as model compound for safe nuclear waste disposal. The focus was on the radioactive element Technetium, which is one of the major radiation sources in nuclear waste.

After my PhD a logical next step was to start a career at ECN on Solid Oxide Fuel Cells (SOFC), where my knowledge on Solid State Chemistry could be utilized further. I worked on SOFC from 1990 through 1998 as scientist and project leader of both large scale EU-projects and industrial projects. One of the spin-off activities of the SOFC developments at ECN was the development of oxygen transport membranes, a field in which I was active from 1998 until 2000. At that time I made the decision to broaden my horizons and dive into fuel processing, aiming for the conversion of hydrocarbons to hydrogen, which field is more directly related to catalysis and reactor engineering, but for which my experience in solid state chemistry prepared me well. This topic was booming at the beginning of the millennium especially due to the then contemporary drive towards fuel cell powered cars and micro Combined Heat Power (CHP)-systems. However the interest in this topic started to cool down over a period of three years, after which I found myself back in the SOFC-field working in close collaboration with a German private company on the development of the ceramic heart of the SOFC-systems. This was a very interesting period, in which I gained a lot of experience while working together with an industrial partner towards a marketed product range. From, 2010 I became involved in the Pd-membrane technology development at ECN, as there was an opportunity to run a large EU-project on the use of Pd-membrane technology in the field of Carbon Capture and Storage (CCS). Last year I was asked to take over also the Carena project as project leader within ECN and as Work Package Manager of WP1. This gave me the chance to further deepen my understanding and knowledge of Pd-membrane technology.



You were a member of the organizing committee of the joint Cachet II, Comethy and CARENA workshop on Pd Membrane (12-14 November 2012, Rome, Italy). Could you tell us your feeling, feedback.. ?

Emma Palo: I am very proud to have been one of the member of the organizing committee. It was very stimulating to organize a workshop collecting all a series of persons belonging to different country with different background and experience. I had the feeling that the workshop would have had a great impact and consensus among participants but it was very impressive for me to recognize how great attention is currently paid to Pd based membrane technology. Especially during the interactive discussion of the last day, it was interesting to observe how many efforts are currently performed for the commercialization of this technology.

I hope that in the future similar workshops and initiatives will be organized, since the shared knowledge can contribute to reduce the gap between the lab scale application and the scale up of the technology.

Frans Van Berkel: Having only being active within the Pd-membrane technology field since 2010, I found it interesting to get the chance to be informed on the overall status of the many different aspects of the Pd-membrane technology as presented by the experts in the field. This broad overview really helps to get one further motivated to push the status of this technology. The workshop opened up for me vistas on how to proceed in order to scale-up the technology to a further mature state. I believe that one of the significant outcome is that the cost level of the Pd-membrane technology should be improved, where issues like robustness of performance, membrane module configurations play an important role. In short, this workshop helped solidify the guidelines I have been working towards refining for my day-to-day work in this field.

What do you think is the most satisfying part of this project?

Emma Palo: A part from the technical results, the possibility to meet and create collaborations with other researchers and industrial partners.

Frans Van Berkel: The most satisfying part of this project or any project is to contribute to and observe the progress of the development process towards the end-product. As I explained in the previous question, this is an important driver for me.

Thank you and all the best for CARENA

Read the full interview online :

<http://www.carenafp7.eu/index.php/Interviews/Interviews.html>



4- Overview : PhD and Post doc about their work subject : Hugues Blasco – CNRS-IEM, France



Hugues Blasco was a Post Doc within the framework of CARENA (oct 2011- oct 2012) at The European Membrane Institute (IEM) in Montpellier, France under the direction of Dr. Anne JULBE.

What was the topic of your Post Doc?

Information on membrane characteristic is essential for membrane user, manufacturer, and scientist to choose an appropriate membrane for specific application, controlling membrane quality or understanding transport mechanism. For example the absence of on-line diagnostic tool is a strong barrier for industry to implement this technology. Our prior and ambitious topic is to develop the feasibility of acoustic emission for on-line detection of defect or failure for membrane reactor in operation.

The second topic is to evaluate the potential of acoustic emission for studying the transport mechanisms through inorganic membrane systems. Acoustic emission (AE) is the phenomenon of transient elastic wave generation in stressed materials. When the material is submitted to stress at a certain level, a rapid release of strain energy occurs as elastic waves which can be detected and analyzed.

Do you have some advice to PhD Student considering taking a Post Doc?

It's the best chance of getting a job in a field that you are passionate about, so make sure you do what you do want to do. Keep in mind that you have to be flexible, you need to take every opportunity to get the best of them.

Initiate collaborations and communicate your results and keep the objective to publish in Nature or Science a day. Creating collaborations, both within your own department and at other institutions is always a rewarding experience. It can lead to exciting new research and help you develop new skills outside from your area of expertise. Have fun with serious things, enjoy yourself with science and you'll become a great generous researcher.

What are your plans after completing your Post Doc?

I can honestly say that despite my misgivings about actually finding an academic job in the current disturbed market, I love what I do and I'm passionate about my research. I'll keep working at the IEM in order to complete my expertise in the membrane area, to publish my results and to extend my list of contacts. Waiting for a good opportunity, I will continue to do good « acoustic work » to boost my chances and get a permanent job, still with a smile !

Thank you Hugues for giving us a glimpse into your progress with research activities!

Read the full interview online

<https://www.carenafp7.eu/index.php/Interviews/Interviews.html>



5- The NASA-OTM, DEMOYS, CARENA and HETMOC Summer School - Inorganic membranes for green chemical production and clean power generation. Valencia, Spain, 4-6 September 2013

We all are concerned by the importance of developing means to reduce global warming and increasing the energetic efficiency in electricity production and chemical production. Membranes can be part of the solution by minimizing greenhouse gas emissions and allowing process intensification.

The school is organized at the [Instituto de Tecnología Química](#) campus (joint center of the Universidad Politécnica de Valencia and Spanish Research Council CSIC).

This event is organized in the frame of four FP7 European projects: (1) [NASA-OTM](#) which aims to develop supported oxygen transport ceramic membranes; (2) [DEMOYS](#) which is focused on the development of thin mixed conducting membranes for O₂ and H₂ separation by using a new deposition technique Low Pressure Plasma Spraying Thin Film (LPPS-TF) in combination with nano-porous, highly catalytic layers; (3) [CARENA](#) that promotes catalytic membrane reactors in the European chemical industry to reduce the dependency of the European community on imported oil; and (4) [HETMOC](#) which will develop and demonstrate highly efficient tubular membranes for oxy-Combustion for implementing cost-efficient carbon capture and sequestration (CCS) in future coal fired power plants.

The school tackles from transport fundamentals through synthesis/manufacturing to final applications of gas separation membranes. ***Specifically the topics addressed along the different sessions are: (1) oxygen transport membranes; (2) hydrogen permeable membranes; (3) advanced manufacturing techniques; (4) application to catalytic processes and advanced separations; (5) theoretical modelling of transport and surface chemistry; and (6) shape-selective separation on porous membranes. In one specific session the different EU projects related with this kind of membranes as well as the [European Energy Research](#)***

[Alliance \(EERA\)](#) initiative will be presented. A special session for students has been allocated in order to give the opportunity to several students to show a brief summary of their PhD research work.

For more information, please visit <http://itqschool.blogs.upv.es/home/>





6- Participation of CARENA's Students to national & international events

The PhDs and senior researchers are active and participate to several national and international events in order to communicate the CARENA's results. Please find more details via this link :

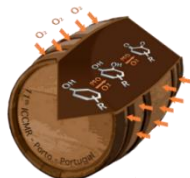
<http://www.carenafp7.eu/index.php/Publications/Publications.html>

Miscellaneous



Participation of CARENA at **EuroNanoForum** which will be held on 18-20 June 2013 in Dublin, Ireland.

11th
International Conference on
Catalysis in Membrane Reactors



Participation of CARENA at the **11th International Conference on Catalysis in Membrane Reactors**, which will be held on 7-11 July 2013 in Porto, Portugal.

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