Organic Nanomaterials – A European Perspective

Véronique de Halleux, Miriam Kreibich, Johannes Rittner and Matthias Seydack

A new EU-funded project is set to put Europe at the forefront of new developments in the application of nano-materials in the organic electronics and photonics sectors. The ONE-P ('Organic nanomaterials for electronics and photonics: design, synthesis, characterisation, processing, fabrication and applications') project has been allocated EUR 18 million under the 'Nanosciences, nanotechnologies, materials & new production technologies' (NMP) Theme of the Seventh Framework Programme (FP7). The project counts 28 partners from 10 EU Member States.

Véronique de Halleux from the Université Libre de Bruxelles (ULB) and Consortium Technical Officer of One-P asked Dr Renzo Tomellini, Head of Unit « Value added materials », for the European view of funding research in the field of materials.

Interview of Renzo Tomellini, Head of the Unit "Value-added Materials"

Dr. Renzo Tomellini, Head of Unit 3 Value added Materials, European Commission

Véronique de Halleux: Why does Europe need to finance research on materials?
Renzo Tomellini: We need better performing materials. So we need to finance research. Materials enable the industrial and commercial success of products and processes. Why do we need to recharge our phone every week and not once every two months or less? Because we do not have yet the right material! New and improved materials represent an invisible revolution; from building materials resisting to earthquakes to light and flexible glasses. Materials are doing the job in the product, we do not see it but it eases or can even change our lives, such as in the searched new treatments based on "nano-medicine" or in novel catalytic materials to de-pollute soil or water.
We also want to reduce the carbon fingerprint of our industrial processes: the environmental impact can be reduced by realizing productions less demanding in energy, biodegradable or more easily recyclable. Just imagine a cheap fully environmentally friendly packaging.

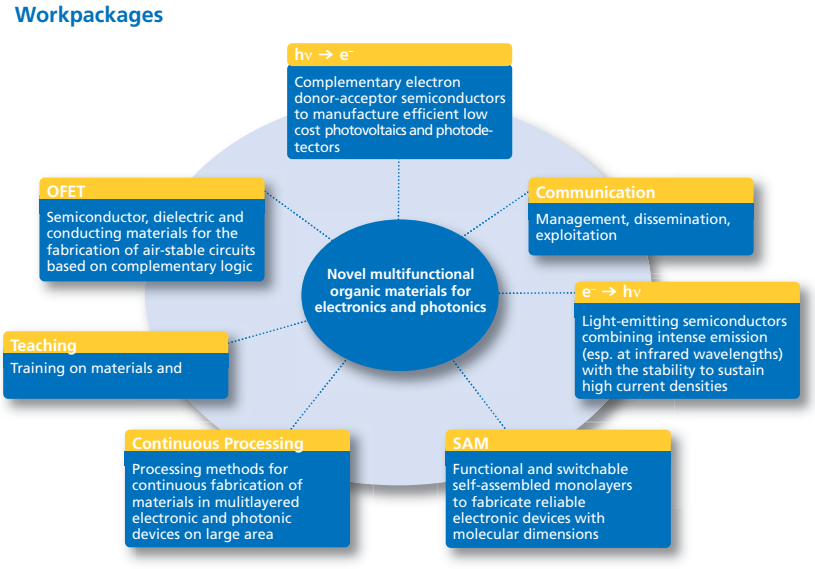
The development of new materials can also solve the problem of availability and dependence. Since most raw materials are not present in Europe or their amount is even limited worldwide, it can be of interest for Europe to develop alternative materials to replace those deriving from elements that are e.g. too scarce or expensive.

Material research helps the European Union to be competitive in selling products. It is a strategic investment for the competitiveness of our industries.

I can conclude stating that materials development is a key element in industrialized countries. Mastering diverse materials can be taken as a measure of the civilization and progress of a society. Materials need human intelligence and knowledge to be realized; they will "bring this knowledge" into products and processes, offering better in-service performance, more safety, less energy demand, no environmental damage… they are KNOWLEDGEmediaries.

VdH: Which type of materials should be developed?
Renzo Tomellini: We should focus on materials that help to reach the political objectives of the European Union in Health, ICT, Energy, Security, Environment, Transport, Food, Agriculture, Fisheries, Biotechnology, Space… better quality of life and safety for the European citizens within a sustainable development approach.

We should focus on materials that add value to European Union products and make our industrial production "greener", safer and less energy-consuming. For the MP3 digital audio encoding, materials are key. Materials showing a very large magnetoresistance, known as Giant MagnetoResistance (GMR) are also an example of successful research. Indeed, this discovery revolutionized the sen-



The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 212311 of the ONE-P project.

This figure depicts the main areas of work within the One-P project.

sitivity of hard disk drive read heads, allowing for miniaturization of electronics as we now know it: pocket-size digital music players and laptops with more memory than desktop models. This invention consequently created economic growth and new jobs.

VdH: Europe creates knowledge and import technologies. Integrated projects have been introduced to tackle the problem. Is it working?
Renzo Tomellini: Is it working? We constantly ask ourselves such question and this is why we have launched an assessment of the Integrated Projects of the Sixth Framework Programme. It is too early today to give you a complete picture as the assessment is now ongoing. As a "bonus" this will also help identifying some best practices that might be implemented in the future.

The EU Framework Programmes bring academia and industrial researchers together on a project. This approach is not tout court common in other parts of the world. However, to solve this "European paradox", a common culture should be established between industrial partners and academic professors. Indeed, sometimes they are not speaking the same language e.g. academic professors may want to sell research and industrial partners want to buy solutions in order to improve competitiveness. They need to understand each other and to find common ground to collaborate effectively and generate successful innovation.

VdH: What about the different instruments that have been developed by the European Commission: European Research Council projects, Integrated projects, Public-Private Partnerships, …?
Renzo Tomellini: The European Commission has introduced a system of support to research and technological development that works coherently and in synergy. There are different funding schemes, which are complementary.

I make some examples: a research with high scientific and technological challenges ("blue sky research") may receive public funding in the form of a grant.

Organic Nanomaterials for Electronics and Photonics: Design, Synthesis, Characterization, Processing, Fabrication and Applications (ONE-P)

Over the last few years, enormous technological achievements have been made in the field of organic electronics and photonics and some applications such as light-emitting diodes and flexible electronic paper displays are now in an advanced stage of commercialisation. However new functional organic materials are still missing to enable the next generation of applications.

ONE-P, a European project of 28 partners will **develop the missing high-performance, low-cost multifunctional organic materials and their process technology** to strengthen industrialization of the electronics and photonics sector in Europe thanks to the synergy between academic and industrial research and the integration of complementary competences.

Duration: January 1, 2009 to December 31, 2011
Budget: 26 million euro (max EC contribution: 18 million euro)
Partners: 15 universities, 5 research centres and 8 Industrial partners or SMEs, thus 28 organisations and around 200 researchers.

Website: http://www.one-p.eu

Then… the lower the technological challenge, the higher the industrial interest for potential research results, the higher the percentage of private funding. You may recognize here the differences that are featured e.g. in the European Research Council (ERC), "Cooperation" specific programme in FP7, Joint Technological Initiatives, Public-Private Partnership, EUREKA… When the technological challenge is still present but lower, with maybe high industrial risk, you may find that loans (no longer grants) are made available, e.g. as done via the Risk Sharing Finance Facility (RSFF). In the case of developments opening ways to market, the public authorities may have another role to play e.g. in helping with patenting, regulation, norms, etc.

It is a coherent system that in principle can allow promising fundamental breakthroughs emerging from ERC grants to be developed within an FP Integrated Project and maybe later receive some RSFF loans and be the subject of a "Lead to Market" initiative and finally open up their way to the market.

VdH: How would you define a successful project?
Renzo Tomellini: It is a project for which the return of investment is high, meeting the political goals of the Union. The public money investment leads to a multiple return for the taxpayer's money and the innovation generates growth and jobs.

Some ingredients could be an ambitious vision into the future, secure mastering of the theoretical basis, filling the remaining knowledge gaps, establishing and validating modeling to predict properties, carrying out the needed experimental work… A successful project should have a system approach taking into account all the factors of success as well as the whole lifecycle of materials, considering all aspects from the raw material, the industrial transformation or manufacturing process, up to the end of the life chain and reuse or recycling of the final product.

The researcher's intelligence and creativity will then originate new valuable industrial products and sustainable production processes. This is knowledge-based development.

The ONE-P project will work in the fast-growing world of organic, carbon-based semiconductors. Unlike their silicon-based counterparts, these have low fabrication costs and their production is much kinder to the environment, as it uses less energy and generates less waste.

The Sixth Framework Programme (FP6) financed many successful projects in the field of Organic Electronics; these developed a wide range of novel technologies and helped to cement Europe's position as a world leader in the field.

Nevertheless, bottlenecks to the further development and wider application of these exciting new technologies remain, e.g., (i) the development of organic light emitting semiconductors combining intense infrared emission with a sufficient stability to sustain high current densities, (ii) functional and switchable self-assembled monolayers, (iii) complementary electron donor-acceptor semiconductors as the basis for efficient organic photovoltaics and photodetectors and (iv) organic dielectric and conducting materials for the fabrication of air-stable circuits. This is where the ONE-P project comes in. During the three-year project, the researchers will develop new nano-materials for use in field-effect transistors, photovoltaic cells, photodetectors and organic light-emitting diodes (OLEDs), among other things. If all goes according to plan, the materials developed through the project will be stable, easy to process, cheap and environmentally friendly.

The project results should represent an exciting opportunity for business; the ONE-P consortium includes six high-profile companies, all of which hope to turn the project results into commercial products and services, generating jobs and wealth in the process.

In a second interview Yves Geerts, Professor of chemistry at ULB and project co-ordinator of One-P was asked for his opinion about Europe's need for research on (nano)materials for electronics and photonics.

Interview of Yves Geerts, Coordinator of the European Project: Organic Nanomaterials for Electronics and Photonics (ONE-P)

Prof. Yves Henri Geerts, Professor of Chemistry at the Université Libre de Bruxelles (ULB), leader of the Laboratory of Polymer Chemistry and co-ordinator of One-P.

VdH: Why does Europe need to finance research on materials for electronics and photonics?
Yves Geerts: In the last century, scientific developments in two sectors have really revolutionized our lives: namely, information and communication technologies (ICT) and healthcare. ICT developments had a high impact on people lives and access to information. To mention only one aspect: ICT field helped the propagation of humanist ideas and protection of human rights through diffusion of information from multiple sources. ICT industry creates job and wellness, but is nowadays mainly established in Asia and US. This industry, based on silicon, is capital intensive and uses considerable energy for the production of new equipments. On the contrary fabrication processes of organic nanomaterials and applications based on these materials are more energy-efficient. Therefore, the European investment in organic nanomaterials for electronics and photonics is very strategic. Moreover, European industry is already strong in the chemistry and material production sectors as well as in related sectors such as equipment manufacturing. Thus an investment in organic nanomaterial will strengthen these sectors too.

An example of success stories, in the field of organic electronics is Plastic Logic, a spin-off of UCAM. It opened, in Dresden, world's first commercial electronics manufacturing factory to fabricate active matrix displays that are thinner, lighter and more robust than the conventional glass silicon displays. Why Plastic logic decided to be based in Dresden? Because of the 3 M: MAN, the personnel are well qualified and trusty, MACHINES; Dresden is closed to machine industries and MATERIALS to material provider industries.

This investment in organic nanomaterials for electronics and photonics should mainly contribute to the development of applications in three sectors: ICT, Health, and Energy.
In ICT, the development of flexible electronic paper displays will probably change our life, the life of press industry and books editors. It should also have an important impact on paper waste.

In Health, the development of low cost sensors should allow establishing fast and reliable personal medical diagnosis. For example, up to now, heat detectors have been used to detect flu. A more specific and reliable detector analyzing a drop of saliva would allow a better control on epidemics.

In the Energy sector the development of efficient organic light emitting diodes for lighting applications should change Interior design architectures and reduce energy consumption.

VdH: Europe creates knowledge and import technologies. Integrated projects have been introduced to tackle the problem. Is it working?
Yves Geerts: European funding, and in particular the Seventh Framework Programme, is only a few percent of the total research funding in Europe. Thus Integrated projects will not solve the problem alone. However, they are very important to show good practice, for example, they show that academic and industrial partners can work together. Moreover they have evident multisectorial and transnational characters.

The problem in Europe is more a mentality problem: success is not valued enough in Europe and Europeans do not accept easily the right to make mistakes.

Another instrument that could help to "transform" knowledge into technologies in Europe is fiscal incentives for industries to invest in research: European industries should be stimulated to finance fundamental industrial projects in academia and to strengthen their own research capacities.

VdH: How would you define a successful project?
Yves Geerts: It is a project that reached the technological goals fixed at the start and from which materials and technological developments are valorized in the industry.

Contact:
Dr. Véronique de Halleux
Université Libre de Bruxelles (ULB)
Boulevard du Triomphe CP206/01
1050 Bruxelles
Belgium
E-Mail: vero.one-p@ulb.ac.be