PLACE-it Newsletter II

Platform for Large Area Conformable Electronics by InTegration

Welcome to the second issue of the PLACE-it Newsletter.
PLACE-it is a EC funded project within FP7 (ICT-248048), see: www.cordis.lu. In the project we develop a platform for conformable optical systems, based on light-emitting foils such as OLEDs, stretchable materials and/or fabrics. With this integration platform, the building blocks can be combined to form conformable opto-electronic systems such as smart bandages or (automotive) interior lighting applications.
This newsletter has the ambitious aim to support the dialog between the PLACE-it Consortium and the development communities, which are working on similar topics, respectively potential customers.
In the second issue we will focus on medical demonstrators and continue with the partners presentations. Additionally we will inform about the resent activities and upcoming events.
The following issues will keep you on track about the progress of the project, new applications, market news, information and activities around of our subject from inside and outside of our project.

Content Issue No. 2:

I The Project

“Light medicine”

I have to admit that I start to write the introduction to the newsletter, when everything else has fallen in place. A short glimpse into this issue and I have quickly realized that medicine is the main topic of the technical pages of this issue. The issue is actually dedicated to the demonstrator which detects renal diseases. It is the prospect of a fantastic new technology which avoids considerably more unpleasant ways of physical examination, which makes this demonstrator so exciting. Furthermore it is a prototype for a new principle to detect severe diseases – not only of the kidneys.

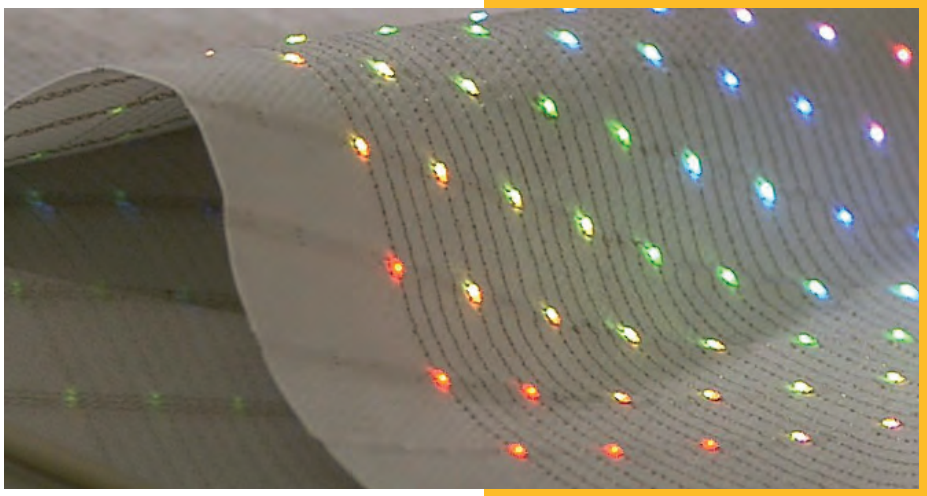

Fig. 1: LEDs on textile

Starting the second issue with the description of a demonstrator is unusual. Most readers would have expected an overview over the current status of the basic technologies here. In addressing the demonstrator side, we would like to line out the technology pull in the PLACE-it project. We do not intend to find new markets, we have applications where we look for solutions. Nevertheless we have not forgotten those, who are interested in an overview over our basic technologies. Just stay tuned for the third issue, which will be dedicated to the status of the base technologies at the midterm of the project.

Besides the technical pages some more PLACE-it partners have their word to describe their plans and their competences. Furthermore we would like to draw your attention to the upcoming events the trade fairs where the PLACE-it project will be represented.

Now let’s come back to medicine. I love the double meaning of the word light, which is more than appropriate to describe our efforts in the PLACE-it project. We want to use light to examin physical conditions and to treat diseases. And we want to introduce light medicine in the sense that our examinations and treatments should not have heavy side effects.
Now, please enjoy reading...

SEVENTH FRAMEWORK PROGRAMME
RESEARCH
www.place-it-project.eu

I The Project

Smart bandage for renal function monitoring

Medical background

Worldwide the incidence of end stage renal disease (ESRD) is rapidly increasing. However, the progressive chronic kidney disease leading to ESRD does not show symptoms until late stage of the disease. The only treatment of ESRD is renal replacement therapy (kidney transplantation or dialysis), where dialysis is one of the most cost intensive treatment options in public health care (35,000 € - 50,000 € per patient per year). The major cause for the development of chronic kidney disease is Diabetes mellitus and Hypertension[1].
In the USA about 13% of the population suffers from Diabetes mellitus[2] and 23% of the population of the age 35 years and older suffer from hypertension. In Germany about 7% of the population suffers from Diabetes mellitus[3] and even 44% of the European population of the age of 35 years and older suffer from Hypertension[4].

Nowadays, diagnostic tools for evaluating renal function are either precise and highly complex (clearance determination using exogenous markers) or easy to conduct, but inaccurate (clearance estimation using endogenous markers). Guidelines of medical societies request the development of improved methods for the evaluation of renal function.

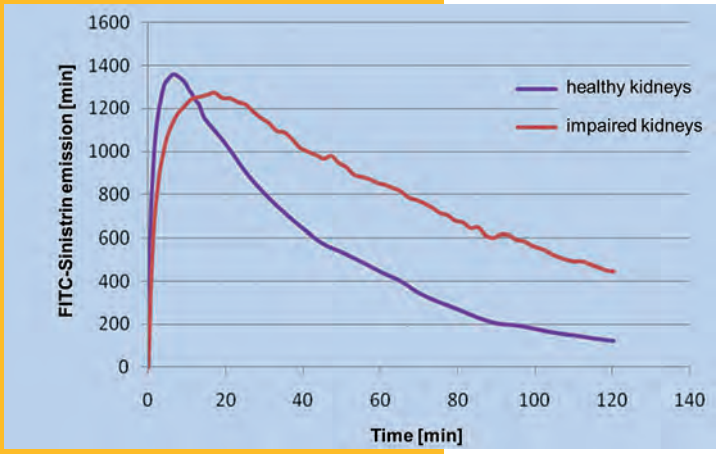

Fig. 2: Elimination of FITC-Sinistrin corresponds to glomerular filtration rate (GFR)

Aim

In the PLACE-it project a flexible fluorescence measurement device for the assessment of the elimination kinetics (and therewith renal function) of the renal marker FITC-Sinistrin (water-soluble fructan linked to fluorescein-isothiocyanate), which is exclusively excreted by the kidneys shall be developed.

For the measurement process, the device is placed on the skin for a baseline measurement before the marker substance is injected. After the substance injection the sensor plaster measures the changes of fluorescence in the interstitial space of the skin over time. The data gained is transferred to a computer to calculate the half-life, and thus the glomerular filtration rate (GFR). GFR or half-life represents a suitable and generally accepted indicator/measure of the renal function.

A rapid decline represents a good renal function, while a slow decline indicates a poor one. (see schematic curves in Fig. 2)

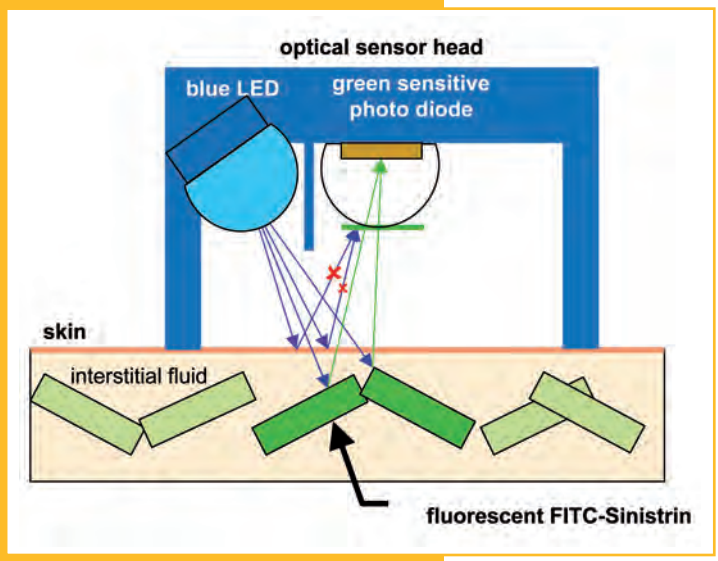

Fig. 3: Functional principle of renal function sensor

Device and procedure

Meanwhile the measurement device is consisting of an inorganic LED, an inorganic photodiode, a µcontroller, an RF-sender and a battery.

The blue LED excites the fluorescent label of the marker in the interstitial fluid of the body, the emitted green light which represents the amount of fluorescent FITC-Sinistrin in the body is measured by the photodiode. The separation of the blue reflected excitation light and the fluorescent green light is done by a green selective photo diode. For a precise optical separation a special optical green filter is used additionally.

The blue light is a secondary effect caused by the skins reflection behavior and is not useful for the measurement of marker substance. The green fluorescent light signal correlates with the excretion rate of the marker substance (FITC-Sinistrin) and therefore the function of the kidney. The faster the disappearance the better the function.

Fig. 4 shows the measuring device adapted for measurements in small lab animals. The optical sensor head is separated from the µcontroller, rechargeable battery and RF-unit.

Fig. 5 presents a comparison of GFR measurements in rat models with healthy kidneys and decreased kidney function either due to genetic disposition or surgery.

In each animal the GFR was simultaneously assessed transcutaneously as well as with a standard test based on the enzymatic measurement of Sinistrin elimination kinetics in plasma samples. A strong correlation of both methods can be seen.

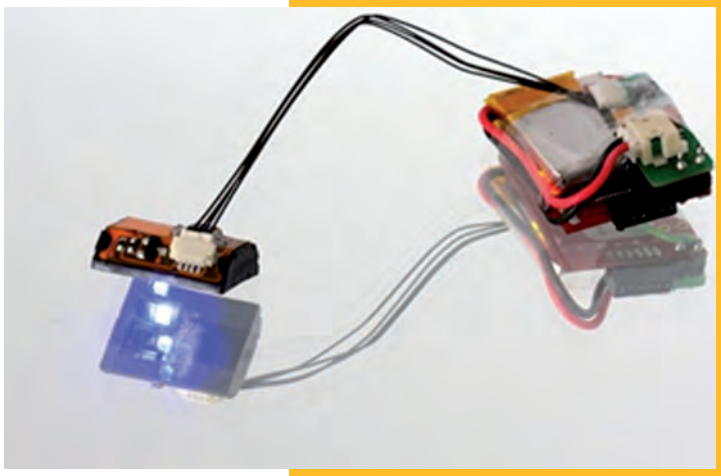

Fig. 4: Measuring device for small animals

Challenges and features

The package of the sensor must be realized with light absorbing material as scattered light must be prevented from the photo diode. Mostly scattered light is ambient light which gleams through thin plastic layers or small gaps. Also direct light from the LED towards the photo diode must be avoided as this can result in a high DC level for the sensor output signal.

Currently, a special black coloured plastic is used with large light absorbing characteristics even if used in thin layer thickness, e.g. 0.4mm. The plastic is processable by injection molding. So the current renal function sensor is assembled with already injection molded parts (built up with rapid prototyping tools).

In order to fix the sensor on skin special adhesive films are used which are also light absorbing. The surface area of the plaster must be wider as the optical sensor head itself. Keep in mind that skin is not completely opaque. The skin allows penetration of visible and infrared light, comparable to a bad optic fibre cable.

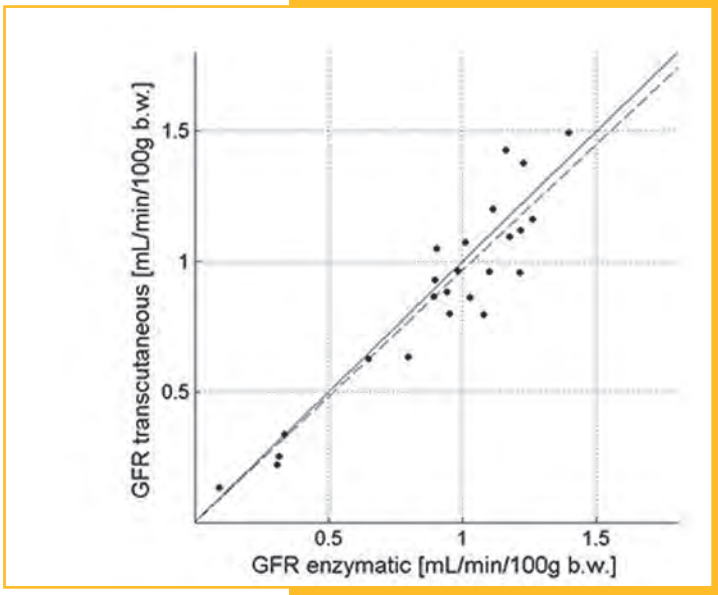

Fig. 5: Comparison of GFR by the transcutaneous method and enzymatic measurement of Sinsitrin.

As a check of the renal function takes up to 2 hours the data can be logged by the µcontroller into RAM during the measurement, so the data is stored offline followed by a read-out afterwards or the data is simultaneously transmitted via ISM / Bluetooth. In latter case the environment must be considered, e.g. is there a risk in intensive care units for ISM/Bluetooth. The measurement device is classified as low power electronic, so measurements up to 2 hours are possible.

The current design is based on flexible polyimide. In a special design a demonstrator is planned on stretchable substrates during the course of the project. Even an option of using OLEDs for excitation light is planned. The flatness of OLEDs and organic Photodiodes allow creating a flat device. For this issue the light guiding will be reviewed. Furthermore flexible OLEDs and Photodiodes would allow to realize sensor on a flat area.

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[1] U.S. Renal Data System, USRDS 2009 Annual Data Report:. Atlas of Chronic Kidney Disease and End-Stage Renal Disease in the United States, National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases, Bethesda, MD.

[2] Plantinga, L.C., et al., Prevalence of Chronic Kidney Disease in US Adults with Undiagnosed Diabetes or Prediabetes. Clin J Am Soc Nephrol.

[3] Deutsche Diabetes-Stiftung (DDS), Jahresbericht 2008.

[4] Wolf-Maier, K., et al., Hypertension prevalence and blood pressure levels in 6 European countries, Canada, and the United States. Jama, 2003. 289(18): p. 2363-9.

II The Partners

The role of each Project Partner in the PLACE-it Project and the Partners Experience.

To get a quick insight into the major markets, products and competences of the project participants, please take a look at their homepages or if you like more in-depth information, please contact the project partners via our project homepage.

Philips Research Eindhoven	www.philips.nl	Koen van Os
• Coordinator, WP1 and WP5 leader, role in textile integration • Coordinator of various EU-funded projects System design and realization of electronic textiles		
TNO Science and Industry	www.holstcentre.com	Dr. Margreet de Kok
• WP3 leader, WP9 leader, Develop foil technology • System in foil, Roll to roll technology, OLED, OPD		
Technische Universität Berlin	www.tu-berlin.de	Dr. Thomas Löher
• WP 4 leader, Develop stretch and textile technology • Integration of electronics in stretchable and textile substrates		
Freudenberg Forschungsdienste	www.forschungsdienste.de	Dr. Jürgen Günther
• WP 8 leader, realization of demonstrators, foil and stretch technology • Integration into products for automotive and also general industry, dissemination, exploitation		
Interuniversitair Micro-Electronica Centrum	www.imec.be	Johan de Baets
• Interconnection technology, electric circuitry, optical simulation and realization of functionalities WP 6 leader • Interconnection of microelectronics and integration in various substrate materials		
Centexbel	www.centexbel.be	Dr. Bernard Paquet
• WP 7 leader (validation), textile technology development, integration technology • Innovation on textile technology (knitting), testing centre, standardisation, support of industry by advising and research		
TITV Greiz	www.titv-greiz.de	Dirk Zschenderlein
• Development and testing of woven textile systems • Innovation on textile technology (weaving), integration of smart electronics		
Philips Lighting	www.lumalive.com	Dr. Mikhail Sorokin
• WP 2 leader (requirements and specifications), exploitation as enduser • Light and wellbeing, phototherapy, OLED fabrication		
Grupo Antolin	www.grupoantolin.com	Ricardo Ureta Hortiguela
• Exploitation as enduser, provide end user insights, Validate demonstrator • Development, production and sales of automotive interior components		
Zentrum für Medizinische Forschung	www.ma.uni-heidelberg.de/inst/zmf/	Prof. Norbert Gretz
• Design and validate demonstrator, exploitation, training • Biomedical equipment, clinical testing, (biocompatibility)		
RWTH Aachen	www.rwth-aachen.de	Christine Mercedes Volkmar
• Biocompatibility tests, exploitation, demonstrator • Dermatology, phototherapy		
Ohmatex	www.ohmatex.dk	Torben Schaltz
• (power) connector design and realisation • Interconnection technology		

PLACE-it partner Freudenberg Forschungsdienste (FFD)

Over 70 years experience in the field of polymer materials and the commitment of enthusiastic scientists and researchers are the basis for the competence of the Freudenberg Forschungsdienste KG, in order

- to develop and to optimize (materials and processes),
- to calculate and to simulate (elastomer and plastic components and processes),
- to test and to analyze (physical and chemical investigation, as well of surfaces),
- to conduct failure analysis (of elastomer, metal, and plastic parts and their composites),
- to produce (samples, small series and processing aids) for our customers.

Fig. 6: FFD

More than 200 specialists from chemistry, physics and engineering sciences rely on comprehensive equipment such as: CT, SEM, IR microscopy, high-speed contact angle measurement, electron spectroscopy for chemical analysis, hydraulic testing machines and various machines for elastomer testing and processing like injection and compression molding.

FFD has experience in EU-development projects like Cirrµs, Flexnolead and it was recently coordinating the STELLA consortium.
With its internal partners many years of experience are available in producing flexible printed circuits, both using PET/PEN as well as PI. Therefore, FFD is well suited and prepared for the following tasks: Integration; identify and develop new methods of interconnect and heterogeneous integration on/into flexible and stretchable substrates; Processes; check whether processes are technically feasible and can be industrialized and establish processes to generate simple structures of PLACE-it on production equipment.

For more information, contact:
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PLACE-it partner Zentrum für Medizinische Forschung (ZMF)
(Medical Research Center)

The University of Heidelberg is closely affiliated with highly known institutions in Heidelberg such as the German Centre for Cancer Research, the European Molecular Biology Laboratory and four Max Planck Institutes.

The Medical Research Center is a core scientific facility of the Medical Faculty Mannheim of the University of Heidelberg. It provides a framework for the multidisciplinary, patient-oriented, animal-experimental and molecular and cellular biological research. It includes laboratories for biochemistry, cell biology, molecular biology, and also PC workplaces for researchers.

The institute/faculty offers innovative course programs for undergraduate and graduate students in Germany in the field, including e-learning modules.

Fig. 7: ZMF

The department of experimental medicine of this centre has developed a monitoring system for renal function and this department will contribute to PLACE-it. Developing a conformable light source is of prime importance and will support the exploration of application field to a great extent.

The Medical Research Center will therefore contribute as end user in WP8 demonstration, where they will build a flexible device (foil/plaster) for the transcutaneous measurement of organ functions, e.g. glomerular filtration rate (kidney function) based on organic electronics. In addition they will contribute to compatibility tests in WP 7 testing and in defining requirements and specifications in WP2. The e-learning modules will be part of the dissemination and training of PLACE-it.

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PLACE-it partner TU Berlin (TUB)

Fig. 8: TUB/IZM building in Berlin Wedding, industrial site of former AEG now hosting several high-tech and spin-off companies.

Technische Universität Berlin (TUB) was established in 1770 as a school for mining. Its present name and constitution was inaugurated in 1946. Today around 30,000 students, a scientific staff of 3000 and 2100 employees in infrastructure and administration are learning, teaching, and working here. TUB is member of “GIT 9”, the nine largest German institutes of technology.

The Microperipheric Technology Research Centre was established under the chair “assembly and interconnection technologies” in the department of high frequency and semiconductor system technologies in the school of electrical engineering and informatics. The center with around 60 employees is headed by Prof. Klaus-Dieter Lang. A large variety of topics in microelectronic packaging and miniaturization in the fields of industrial, automotive and medical electronics is jointly addressed by TUB and its partner institute Fraunhofer IZM.

Project highlights in the past years were the European funded projects HERMES and TIPS on the direct embedding of thin semiconductor chips into printed circuit boards for modularization and miniaturization of electronic systems. A strong recent focus is on stretchable electronic systems and integration of electronic functions into textiles. In the frame of the European project STELLA a technology for the realization of stretchable electronics was developed, which is presently tested in diverse application environments. A number of technical approaches and solutions for textile electronics were developed in CONTEXT and further projects. The joint institute is among the leading international research organizations in these fields.

The range of equipment at TUB comprises large size printed circuit board manufacturing and processing, textile lamination, sewing and embroidery machines for processing and analytical tools like various types of microscopy (optical, SEM, x-ray), electrical and mechanical test equipment.

In PLACE-it the main contributions by TUB are consequently in the field of stretchable and textile electronics.

Especially the integration of light emitting devices (LEDs and OLEDs), the lateral intensity distribution and light sensing are mayor topics. With respect to future exploitation of the technologies both fields still deserve further development and efforts to enable the industrial manufacturing on one hand. On the other hand PLACE-it allows to explore further fields of applications in prove of concept assays.

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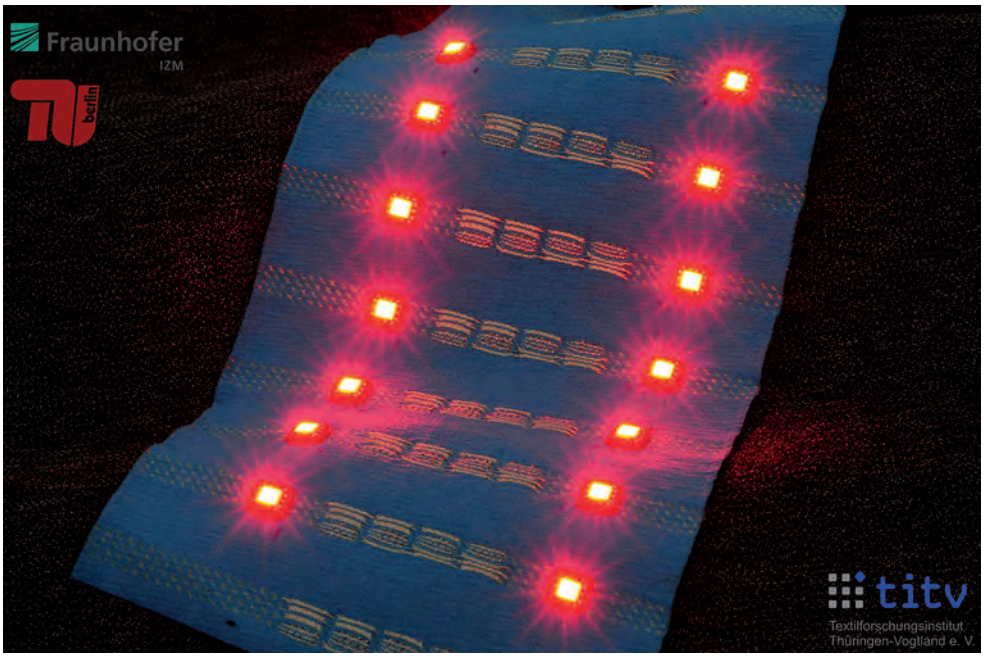

Fig. 9: Woven Quadropol Fabric with RGB-LEDs bonded with non-conductive adhesive.

Hannover Trade Fair 2011

The project was presented in three major fairs, the Hannover Industry Fair, the Techtextil and the SYSTEX Salon.

The booth at the Hannover Industry Fair (April 2011) can be seen in the picture on the right side. The showcase was equipped with samples from the project. The largest sample was a Philips sample with LEDs attached to a non-woven material containing electrically conductive yarns. (see Fig. below)

The 1st newsletter of PLACE-it, the 6th newsletter of the STELLA project and the flyer of the Flex & Stretch Workshop were displayed beneath.

Prior to the fair a number of press releases were provided either for the website of the fair but also from the corporate communication department of Freudenberg. The lighted samples in the showcase attracted particular interest and a number of samples on the small tables were also frequently touched starting a lot of discussion. Important items were dealing with the technological maturity, industrialization issues and the timeline of our project.

Fig. 11: Large non-woven sample with LEDs attached

Fig. 10: Booth at the Hannover Trade Fair

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Techtextil 2011

This fair took place in Frankfurt (end of May) and two partners were present: TITV was active in a cooperative booth and Philips gave a oral presentation about integration of electronics into textiles

The discussions with the audience focused on the production process to make sure that highly automated manufacturing is possible. This is a goal but also a challenge in the project and will be handled on the technology level as well as on cost calculation level (manufacturability).

At the Avantex 2011 an interactive police vest – a joint project between the Berlin-Weißensee (School of Art) and the Textile Research Institute Thuringia-Vogtland e.V. (TITV Greiz) was presented. This interactive light textiles Tex-vest was honored with Avantex-Innovation Award.

(www.titv-greiz.de/uploads/media/Pressemitteilung-Leuchttextilien.pdf)

Outlook for 2012

The coming year represents the halftime of the project. The focus of the first two years will move from technology development to the realization of the demonstrators. However, the activities of the technology providers will not be reduced but will induce even more the support of the end-users as the owners of the demonstrators. Much more samples and prototypes will be available and shown for sure. Announcements of the fairs will be available on the website.

Fig. 12: Booth at the Techtextil 2011

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Fig. 13: Invitation to the FlexStretch Workshop

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Meet us:

3rd International Workshop on Flexible & Stretchable Electronics

On behalf of the organising committee we would like to invite you to Flex-Stretch Electronics III, the third International Workshop on Flexible and Stretchable Electronics, which will take place in Berlin, Germany from November 16-17, 2011. This workshop is part of the activities of the Integrated Projects PLACE-it and PASTA and other nationally funded projects in the field of flexible and stretchable electronics. Moreover international experts in the field, both from industry and from academia, will deliver key-note talks on the subject. Preceding the workshop a day of tutorials on flexible and stretchable circuit technologies is organised at Fraunhofer IZM in Berlin, where authorities in the field will share their knowledge and views.

Since the first successful workshop, held in September 2007, the technology has made considerable progress, both with respect to applications and to industrialisation schemes.

Discussion during the event will focus on
- Leading edge technology progress and research topics, especially for
  - foil based electronics
  - stretchable electronics
  - smart fabrics
- Industrialization
- Reliability
- Application potentials in the areas of healthcare and automotive

We look forward to seeing you in Berlin in November!
Johan De Baets, Wim Christiaens, Christopher Klatt, Thomas Löher, Liesbeth van Pieterson, Jan Vanfleteren.

See also for more information:
3rd International Workshop on Flexible & Stretchable Electronics
Berlin, November 15–17, 2011
www.flexstretch2011.de

More Upcoming Events:
Hannover Trade Fair
April, 23–27, 2012
www.hannovermesse.de

Read more:

Transcutaneous assessment of renal function in conscious rats with a device for measuring FITC-sinistrin disappearance curves
D. Schock-Kusch, Q. Xie, Y. Shulhevich, J. Hesser, D. Stsepankou, M. Sadick, S. Koenig, F. Hoecklin, J. Pill and N. Gretz
Kidney International
Volume 79, Issue 1, June 2011, Pages 1254-1258

Cyclic endurance reliability of stretchable electronic substrates
F. Bossuyt, J. Guenther, T. Löher, M. Seckel, T. Sterken and J. de Vries
Microelectronics Reliability
Volume 51, Issue 3, March 2011, Pages 628-635

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