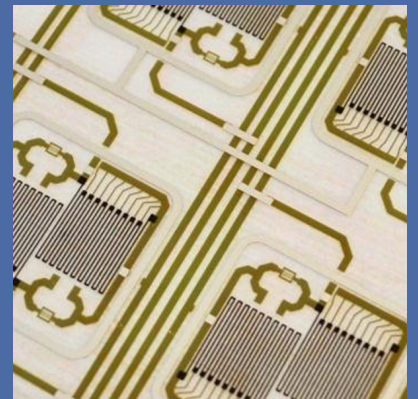


i-FLEXIS NEWSLETTER

4.



september 2015

i-FLEXIS

Integrated flexible photonic sensor
system for a large spectrum of
applications: from health to security

www.iflexis.eu



The project is co-funded by the European
Community under the Information and
Communication Technologies (ICT)



1. SCIENTIFIC CORNER

i-FLEXIS is arriving to its last year of implementation. It is now time to integrate all the remarkable advances made on organic and oxide materials and related devices over the last two years on the i-FLEXIS system that will enable luggage ID tags, health radiation dosimeter and bone density analyzer test vehicles. Hence, the period between April and September 2015 was particularly intense in tuning the performance and stability of the different components and using the obtained properties to design and simulate electrically the performance of the final i-FLEXIS system.

1.1 Scientific Results

STA structures with TIPS pentacene

The characterization of single STA structures using TIPS pentacene as active and sensitive layer has been completed. STA structure allows obtaining X-Rays sensors with tunable sensitivity by the applied gate voltage, in a reproducible way. Such a feature cannot be found in PLA devices, which act as variable resistors. In this configuration, very high sensitivity (as high as 130 nC/Gy) has been obtained.

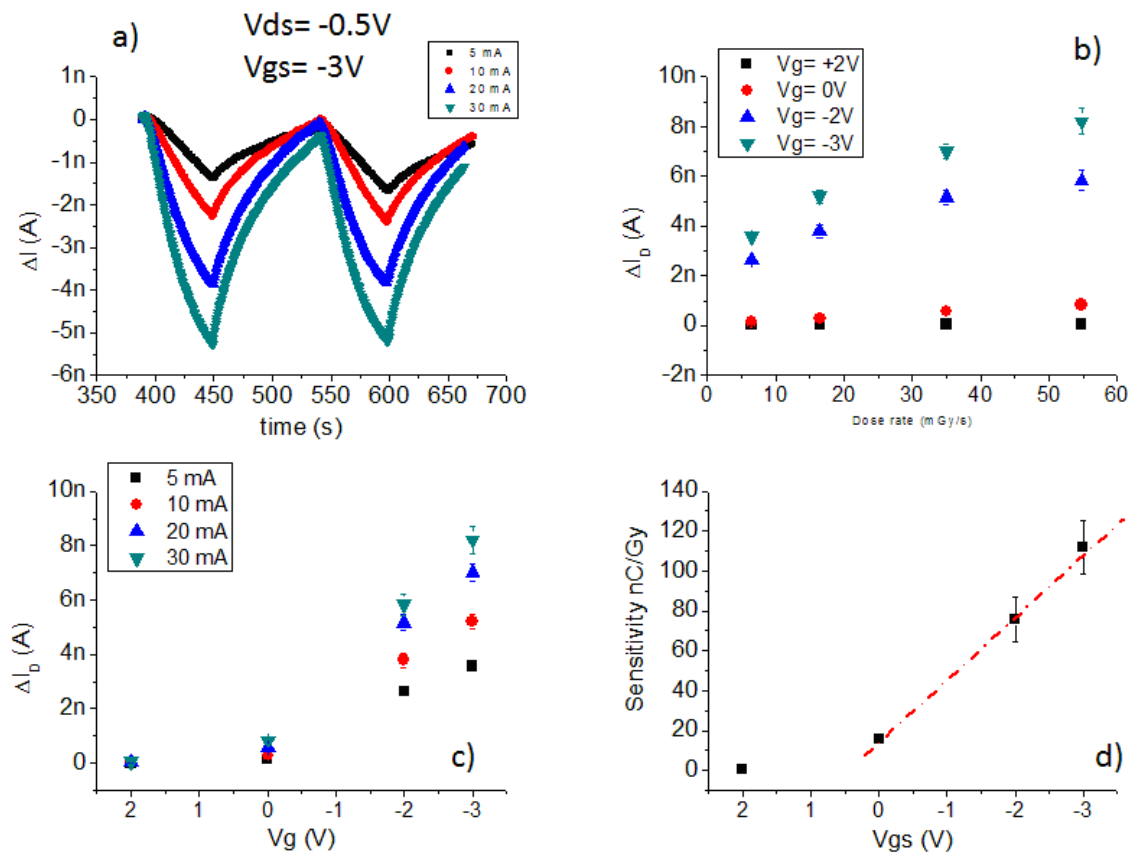


Figure 1: Current variations induced by X-Rays in the linear regime of the transistor (a); calibration curves obtained for different V_{gs} (b); V_{gs} modulation of the X-Rays induced current variations (c); V_{gs} modulation of the device sensitivity (d).

Radiation hard organic photonic detection unit

OSSC based radiation detection units have demonstrated stable operation also after long-term exposure to ionizing radiation. In experiments detector performance has been quantified as a function of total ionizing dose. Provided that mean dose rates do not largely exceed typical values for medical instruments, the detectors sensitivity decreases only slightly and sensitive detection is possible also after TID exceeding 1.1 kGy.

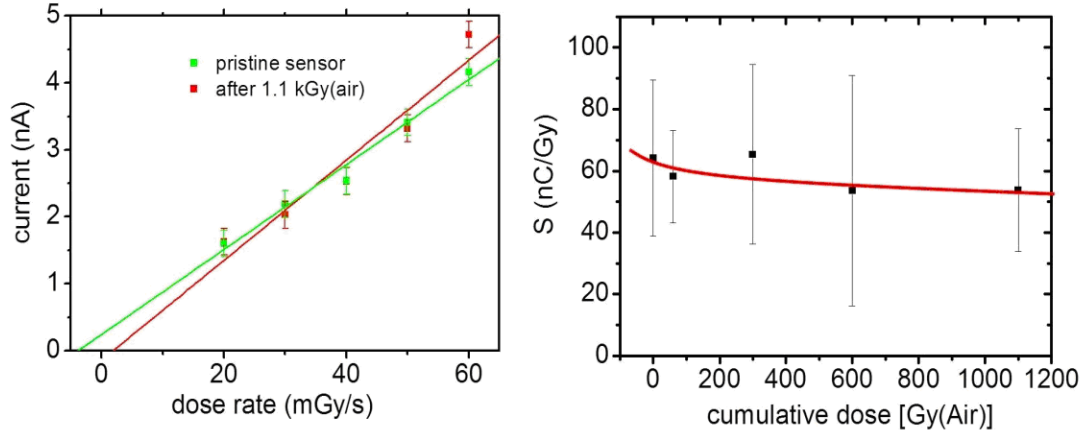


Figure 2: Radiation hardness of OSSC based photonic detection units: (a) photocurrent as a function of dose rate for a pristine detector and after exposure to 1.1 kGy. (b) X-ray sensitivity as a function of cumulative dose.

2x2 matrix using PLA sensor structure

Backplanes including addressing matrix and signal amplification based both on organic and oxide electronics were designed and simulated by CEA and UNOVA, respectively.

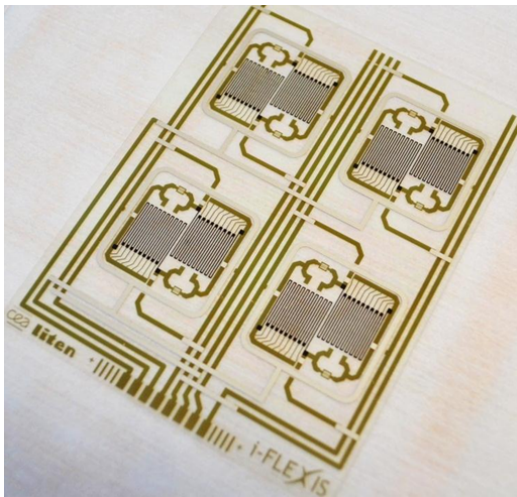


Figure 3: One of the first organic-based backplanes on foil ready for OSSC printing at ELLETTA and

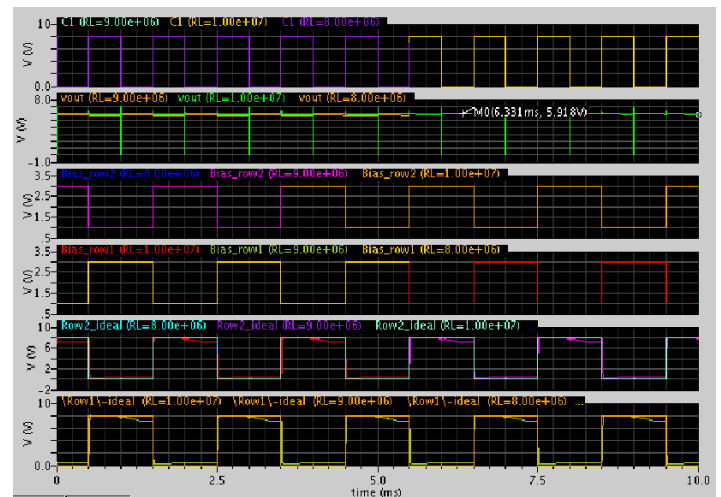
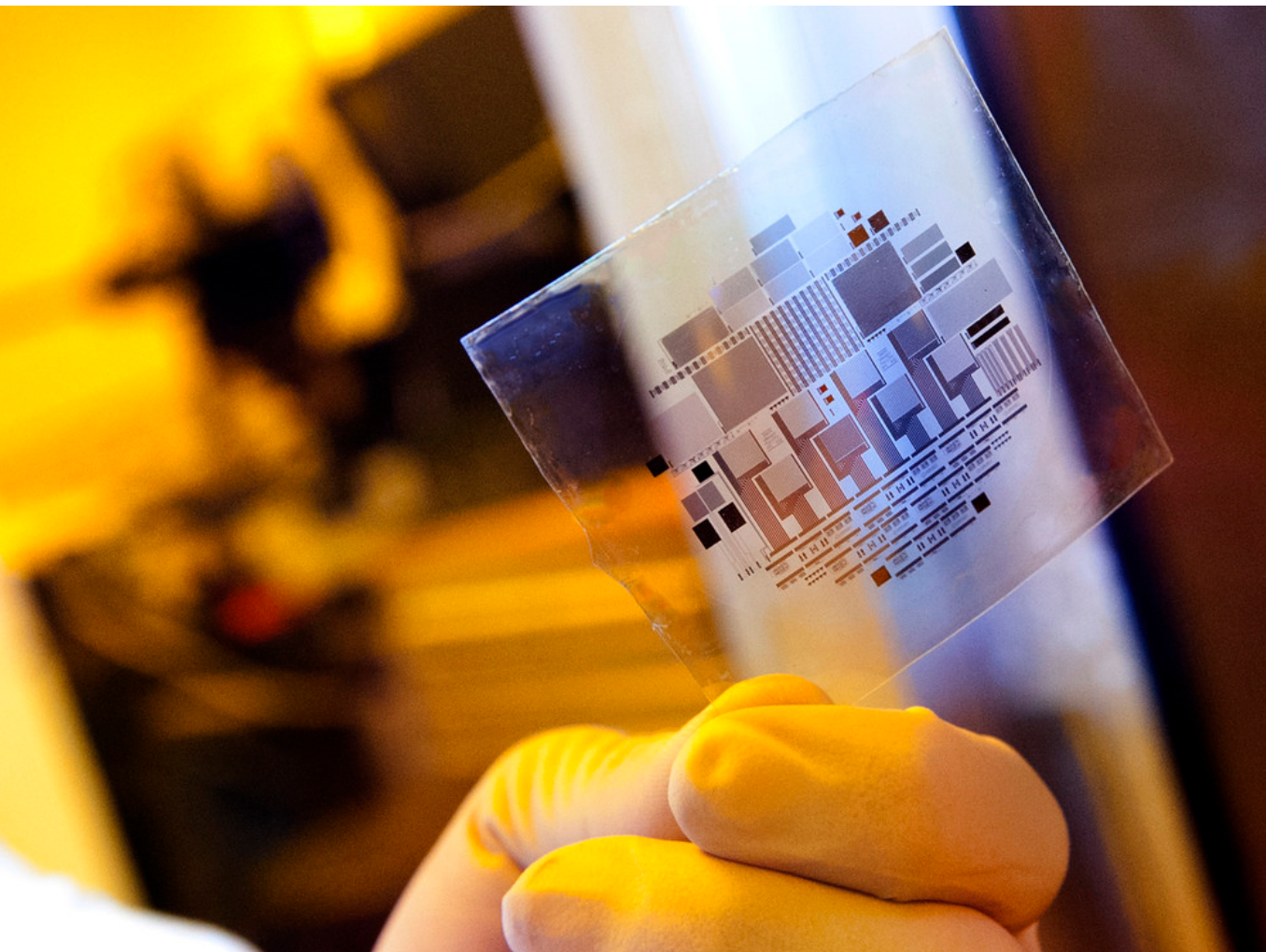


Figure 4: Simulation of the entire backplane using oxide electronics, assuring operation below 10 V. System allows for X-ray level monitoring and pixel identification.

1.2 Deliverables

Six new deliverables were submitted between month 19 and 24:

- **D3.3** – Report on the implementation and characterization of the STA structure (M21)
- **D3.4** – Report on the implementation and characterization of the final pixelized architecture (M24)
- **D4.3** – Delivery of the oxide CMOS TDK (M22)
- **D5.2** – Quantitative assessment of the photonic sensor unit radiation hardness and degradation specifications (M24)
- **D6.1** – Identification of the “LEGO” building blocks structure needed for each specific application (M18)
- **D7.5** – i-FLEXIS summer school, including dissemination material such as flyer and posters (M24)
- **D7.6** – i-FLEXIS workshops/symposia (EMRS), including dissemination material (M20)



2. MEETINGS

In the period between April and September only the 2nd review meeting took place, with the 5th general assembly being scheduled for October.

2nd review meeting

The 2nd review meeting was held in Brussels during May 27-28th 2015, to evaluate the work carried out during the first 18 months of the project. As in the first review meeting, the review panel was composed by the project officer, Dr. Rüdiger von der Heyden, and by two expert reviewers, Dr. Torbjörn Ericsson (Vice President of Engineering Operations, Thinfilm Electronics AB, Sweden) and Dr. Celeste Fleta (Micro- and Nano-systems Department at the Instituto de Microelectrónica de Barcelona, Spain). Briefly, reviewers emphasized that the project has been successful so far, with good project management and collaboration within the consortium and good quality of technical work, in line with the proposed work plan. It was recommended that the project continues.

Upcoming meetings

The 5th GA will take place in Trieste on October 15-16th 2015, organized by UNITS. Our next newsletter, out in March 2016, will describe main conclusions from this meeting.



3. TRAINING ACTIVITIES

Student and researcher exchange program

Being a project with partners having such a multidisciplinary expertise, an active exchange program of students and researches among partners continues to take place. Two MsC thesis will be presented during October at UNOVA and UNIBO within this context, one by the UNIBO student Allegra Sacchetti (“Novel transparent and flexible electronics transistors for radiation hard environment”) and the other by the UNOVA student Maria Almeida (“Radiation damage in flexible TFTs and organic detectors”). Starting from October and February two more MsC students will go from UNIBO to UNOVA to work on project related topics (“Advanced electrical characterization of oxide TFTs” and “Production of solution based tin oxide thin films”) Giulio Pipan, PhD student from UNITS spent the month of February at UNICA to develop better interfaces for inkjet printing procedures, Umberto Emanuele from BIOAGE spent some time at UNIBO to develop and implement the sensor matrix hardware readout system, towards the realization of the HD sensor test vehicle no.1

4. WORKSHOPS AND SCHOOLS

1st i-FLEXIS Workshop and Spring School at E-MRS Spring 2015

The first i-FLEXIS Workshop and Spring School were both organized in collaboration with E-MRS in order to promote the concepts of the project through a broad audience. In fact, E-MRS Spring Meeting is known to be the largest materials conference in Europe, with more than 4000 attendees in 2014 from academia and industry, from students to well-distinguished researchers.

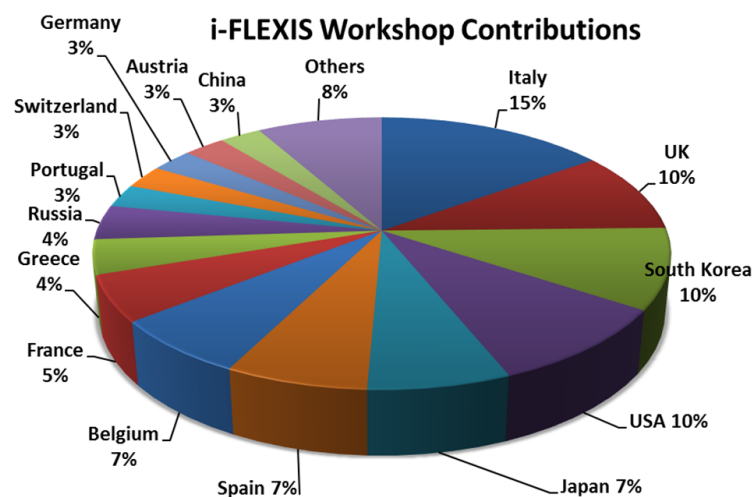
1st i-FLEXIS workshop

The workshop was organized in the form of a symposium of E-MRS (Symposium Q, “**Organic Semiconducting Single Crystals: from fundamentals to advanced devices**”) by Beatrice Fraboni, Alessandro Fraleoni Morgera (both part of i-FLEXIS project, UNIBO and UNITS), Yves Geerts, Alberto Morpurgo and Vitaly Podzorov as a three-day event, between May 12th and 14th. It aimed to bring together leading scientists from a variety of backgrounds (chemistry, physics, engineering and material science), involved in forefront fundamental and applied research on Organic Semiconducting Single Crystals (OSSCs), covering material synthesis, crystal growth, device fabrication, various experimental characterization methods and modeling that reveal the intrinsic electronic and photonic properties of organic semiconductors.

Besides this, regular oral presentations and posters were divided into different sessions, covering **crystal growth, fundamental properties, theory and modelling, charge transport properties, applications to optical, sensing and electronic devices.**

As a special proceeding for the Symposium, a Topical Special Issue on “*Organic Semiconducting Single Crystals: from fundamentals to advanced devices*” will be published by *Advanced Functional Materials* by the end of 2015.

The Workshop/Symposium had an average number of attendees during its sessions of about 100 persons, including more than 80 contributions, from different countries according to the distribution presented in the pie chart below.



During its 3 days, the symposium included oral contributions of 12 distinguished invited speakers:

- C. Daniel Frisbie (Univ. of Minnesota, USA)
- Henning Sirringhaus (Univ. of Cambridge, United Kingdom)
- Taishi Takenobu (Waseda Univ., Japan)
- Alejandro L. Briseno (University of Massachusetts, USA)
- Alessandro Troisi (University of Warwick, UK)
- Simone Fratini (Grenoble, CNRS)
- John Anthony (University of Kentucky, USA)
- Aram Amassian (KAUST, Saudi Arabia)
- Marta Mas Torrent (Barcelona, Spain)
- Helena Alves (University of Lisbon, Portugal)
- Roland Resel (TU Graz, Austria)
- N. Zaitseva, (Lawrence Livermore National Laboratory, USA)

A 2nd workshop / symposium will be organized towards the end of i-FLEXIS, covering advanced electronic sensing systems on flexible and large area substrates.

Figure 5: Attendance statistics per country for i-FLEXIS Workshop / Symposium

1st i-FLEXIS spring school

The Spring School was organized as a one-day event on May 15th at the Lille Grand Palais, France as a satellite event of the E-MRS Spring Meeting 2015 (<http://www.emrs-strasbourg.com/>). The school was entitled “**Flexible Electronic Sensors**”, aiming to provide an introduction on the fundamental aspects and a broad overview on the major issues related to the state-of-the-art materials, fabrication methods and device architectures employed to realize advanced electronic sensing systems on flexible, large area substrates.

Speakers from the consortium and also external invited speakers covered topics ranging from materials and devices to fabrication and applications, i.e., different aspects that are being developed within the project. Program was organized as follows:

Materials

- 9:00** Prof. R. Martins (UNINOVA) – "High mobility thin film oxides for novel flexible devices and sensing"
- 9:30** Prof. B. Fraboni (UNIBO) – "Organic crystals and polymers for radiation sensing applications"

Devices

- 10:00** Prof. A. Bonfiglio (UNICA) – "New transistor structures for low - voltage operation and sensing applications"

10:30 Coffee break

- 11:00** Prof. L. Torsi – "High sensitivity Organic sensors for bioanalytical applications"

Fabrication

- 11:30** Dr. V. Fischer (CEA) - "Device fabrication and patterning for large area flexible electronics"

12:00 Lunch break

Applications

- 14:00** Prof. P. Siffert (EURORAD) – "Large-area organic X-ray detectors"
- 14:20** Dr. C. Loussert (TAGSYS) – "RFID sensors"
- 14:40** Dr. J. Saenz Cogollo (TOY s.r.l.) – "Large-area pressure and strain sensors on textile materials"

Selected papers from the School presentations will be published in a Special Issue: "*Flexible Electronic Sensors*" in the **Journal Sensors** (ISSN 1424-8220), whose guest editors are A. Bonfiglio, E. Fortunato and B. Fraboni.

The spring school attendance was diversified, including 29 people from 10 different countries

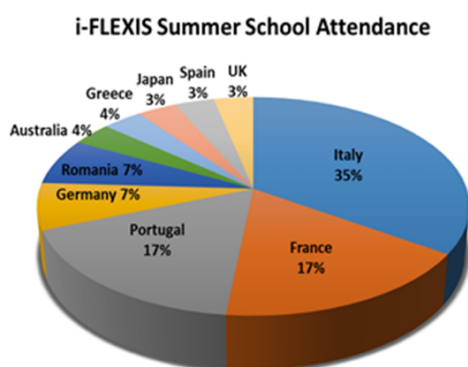


Figure 6: Attendance statistics for i-FLEXIS Spring School.



Figure 7: Prof. Torsi during her presentation.

The overall assessment is that the i-FLEXIS Spring School was a success, and we are working to repeat and even improve the quality for the upcoming 2nd School by the end of the project!