

# i-FLEXIS NEWSLETTER

# 6.



september 2016

## i-FLEXIS

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

[www.iflexis.eu](http://www.iflexis.eu)



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

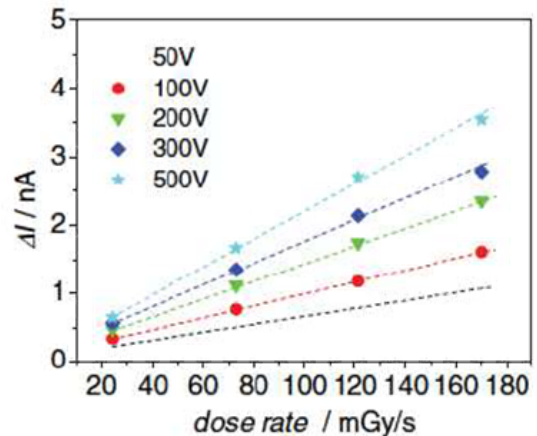
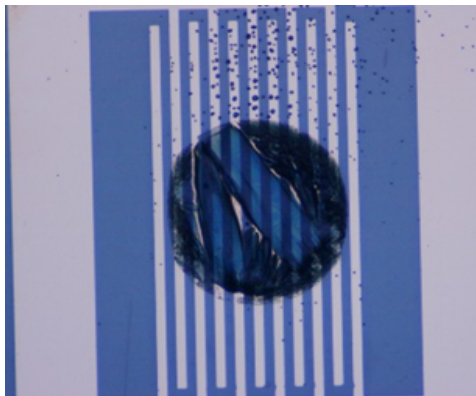


# 1. MAIN ACHIEVEMENTS

i-FLEXIS project reached to its end. The great scientific and technological advances made over these 3 years had the main purpose of developing of an innovative, reliable and low-cost integrated X-ray sensor system based on heterogeneous inorganic, organic and hybrid components. To accomplish this, different areas needed to be addressed by the i-FLEXIS consortium, namely organic semiconducting single crystals processing and characterization, optimization of materials and devices for organic and oxide thin-film transistors (TFTs), design, simulation, fabrication and characterization of flexible electronics and system integration. Main achievements are highlighted below.

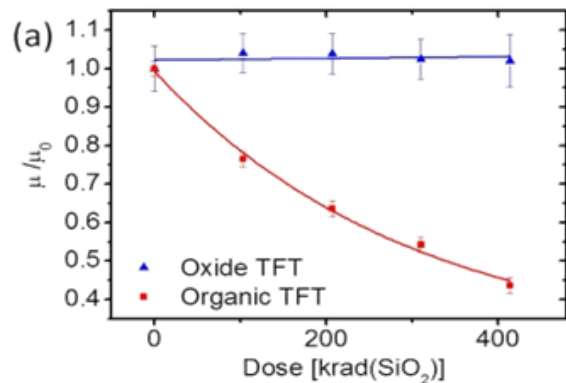
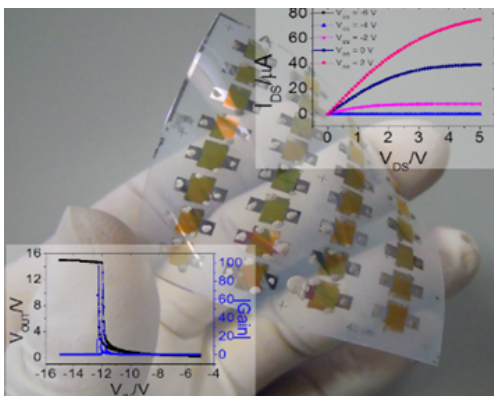
## Organic semiconducting single crystals

- Large database of screened crystals and process optimization, including Ink-jet printed TIPS-Pentacene crystals on interdigitated electrodes.
- Upscaling: ready for ink production at pre-industrial scale.



## Flexible oxide electronics

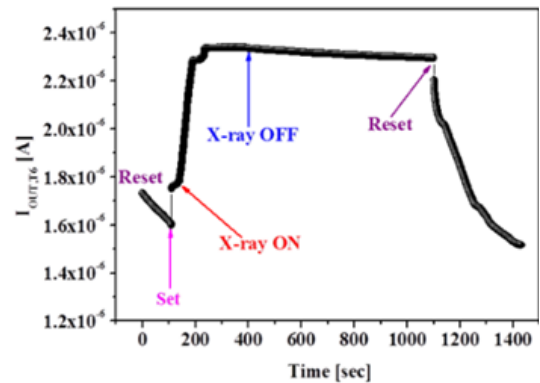
- Low-voltage and self-aligned flexible IGZO TFTs with ultra-thin hybrid insulator ( $\text{Al}_2\text{O}_3 + \text{Parylene C}$ ) @ 150 °C.  $\mu_{\text{SAT}} \approx 10 \text{ cm}^2/\text{Vs}$  and inverters @ MHz level.
- Great radiation hardness of oxide TFTs, even after exposure to 410 krad ( $\text{SiO}_2$ ).



## System integration:

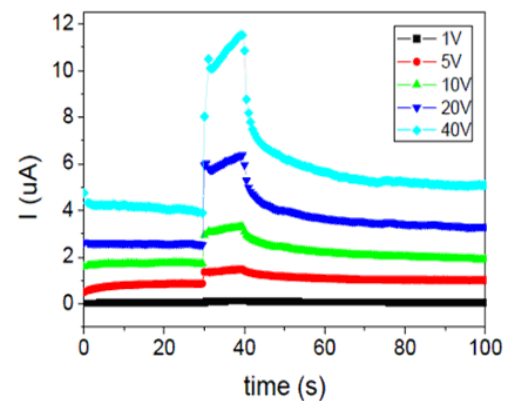
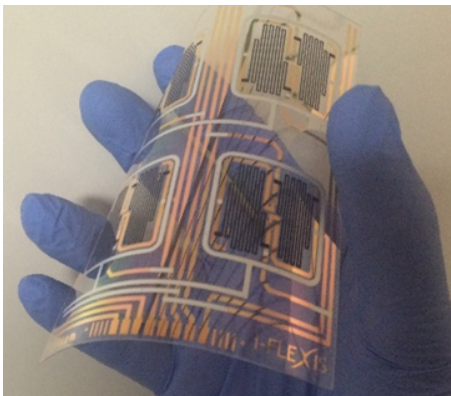
### *Flexible luggage IDTAG*

- Recognizes X-Ray exposure with proper signal variation and stores the information after removing X-rays.



### *Health diagnostics sensor*

- 2x2 active matrix of OSSCs having addressing/readout circuitry based on organics (high V) and oxides (low V)



### *Wearable X-ray detector*

- Detects X-ray, transmits to receiver connected to PC for data reading, saving and processing





## 2. MEETINGS

Two consortium meetings took place during the last 6 months of the project, its main objectives/outcomes are summarized here.

### 6<sup>th</sup> General Assembly, April 2016

The 6<sup>th</sup> GA of the project was held in Lamezia, Italy, between April 14<sup>th</sup> and 15<sup>th</sup>, 2016. It was hosted by BIOAGE, being mostly focused on presenting results from the first generations of the test vehicles and defining strategies to improve them to reach the final goals of the project. During the meeting BIOAGE also organized a large mass media dissemination action in Italian websites, newspapers and television, including a 20 minutes interview in a regional television. Further information related to this event can be found in i-FLEXIS website.



### 7<sup>th</sup> General Assembly, September 2016

The last GA of i-FLEXIS took place in Warsaw, Poland, during the E-MRS Fall meeting (October 22<sup>nd</sup> 2016). The main objectives were to present the status of deliverables due on M36 and to define the last set of measurements required for the final demonstrators. Drafts of the final project report were also presented and discussed per work-package and missing contributions were defined. Finally, demo activities and presentation structure for the final review meeting were discussed.

### Announcement for final review meeting

The final review meeting of i-FLEXIS will be held in Brussels, on November 22<sup>nd</sup> 2016, to present to the project officer and technical advisors all the progress and results achieved during the last reporting period (M18-M36).



### 3. TRAINING ACTIVITIES

Having a consortium with such a broad range of core expertises, including partners from academia and industry, training activities and knowledge exchange were defined as fundamental parts of i-FLEXIS since its beginning in October 2013.

#### Student and researcher exchange program

A total of 22 mobility actions, from short (2-3 days) to long (6 months) term, were performed among partners for technical/scientific collaborative work, involving master and PhD students as well as senior researchers.

- Regarding education, a total of 5 MSc thesis and part of a PhD thesis resulted from these actions, in areas such as radiation hardness of oxide and organic electronics and solution processing of oxide thin films.
- Research mobility was also imperative to enable integration and testing of i-FLEXIS demonstrators, with particular emphasis on the IDTAG test vehicle.

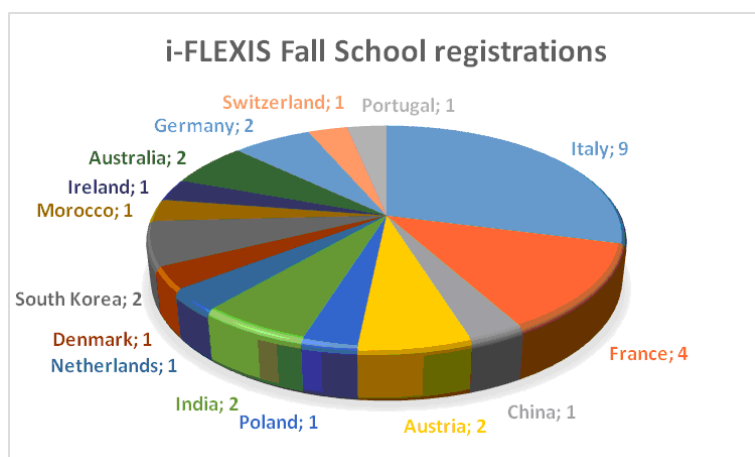
#### Summer/Fall Schools

Two schools were organized during i-FLEXIS project, one on May 2015, other on September 2016. Both schools were organized as one-day events in collaboration with the European Materials Research Society (E-MRS) in parallel with their Spring and Fall meetings, respectively.

The first school was titled “**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.

Towards the end of the project, the second school, titled “**i-FLEXIS X-ray sensors: from materials to real life applications**”, presented the complete roadmap of i-FLEXIS, from materials development to devices, targeting real-life X-ray detection applications. The school covered scientific research develop-

ments, materials integration challenges and technology transfer towards industrial production of X-ray sensor systems. Both schools had around 30 registered attendees and enabled a relaxed but comprehensive communication and discussion of the project concept and results to students and industry level researchers from different countries.



## 4. DISSEMINATION AND EXPLOITATION OF RESULTS

The number of advances required in materials, devices and systems to turn the i-FLEXIS concept a reality enabled the consortium to obtain during these 3 years a large set of results and achievements that needed to be disseminated to different audiences, from general public, to academia and to professional communities dealing with the topic of ionizing radiation detection and protection. From mass-media actions to workshop organization and publication of articles/books, i-FLEXIS was very rich in dissemination actions. Naturally, having such a great potential for real-world applications, IP and business plans for future industrialization were also critically accessed. As a result of the activities performed one patent related to organic crystals and an *enveloppe soleau* were already submitted, with more being currently under study.

### Workshops

Throughout i-FLEXIS, two workshops were organized in the form of 3-day technical symposia in E-MRS Spring and Fall conferences (May 2015 and September 2016). These events covered the main innovations developed during the project, having the first one devoted to “**Organic Semiconducting Single Crystals: from fundamentals to advanced devices**” and the second to “**Flexible Electronic Sensors**”. On average, about 80 contributions were received for each workshop, divided in invited, oral and poster presentations. The large and broad audience of the E-MRS conference series enabled a widespread dissemination and discussion of the topics related to i-FLEXIS project with academia and industry.

### Participation in conferences and publications

i-FLEXIS partners were very active in disseminating the technical and scientific results in international conferences and peer-reviewed publications.

A total of 57 presentations were given in international conferences (Europe, USA and Asia), with half being invited contributions. This clearly shows the importance attributed by the scientific community and industry to the concepts and results achieved during the project, from material synthesis to system integration. Invited presentations were made in prestigious conferences, such as International Exhibition and Conference for the Printed Electronics Industry (LOPEC), International Thin-Film Transistor Conference (ITC), Printed Electronics Europe and Materials Research Society (MRS).



Regarding peer-reviewed publications, the consortium contributed with 26 articles, 2 book chapters and 1 book. These publications focus a large variety of aspects, such as modeling, material and device design/fabrication and characterization (with special emphasis to ionizing radiation sensitivity of organic crystals and radiation hardness of organic and oxide electronics), and even circuit design. Prestigious and high impact-factor journals as *Advanced Materials*, *Journal of Applied Physics* or *Physical Review B*, and world-leading book publishers as Springer are included in this list. For a complete list of publications, please check i-FLEXIS website

### Intellectual property

One patent and one envelope soleau were submitted during the project:

- Patent application ITMI20150652 –

Use of electrode surface modifications for attaining controlled solution dewetting – this describes methods enabling direct print of single crystals precursors that can be used both for X-rays detectors (i-FLEXIS main goal) and other applications (as active layers in organic transistors, for example).

- Enveloppe Soleau 564865 – Health dosimeter – describes real-time & immediate reading finger dosimeter with dose storage option read by thermoluminescence.

Based on the large number of important results achieved, other patent possibilities are currently being investigated.

