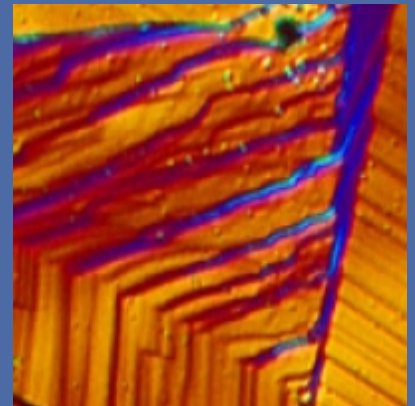


# i-FLEXIS NEWSLETTER

## 3.



march 2015

## 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. SCIENTIFIC CORNER

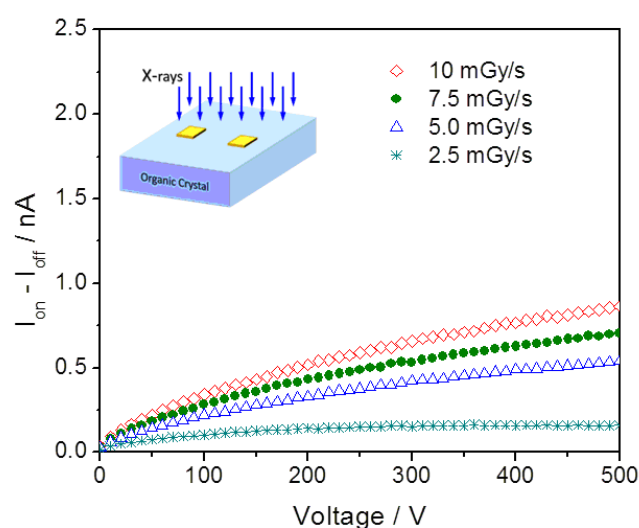
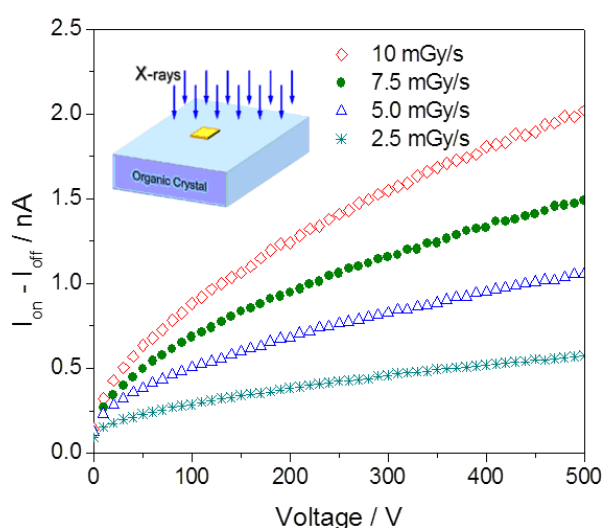
Scientific results and deliverables between October 2014 and March 2015

## 1.1 Scientific Results

With the project now reaching its midterm, the different building blocks enabling the final i-FLEXIS system start to be available for integration. Below is a demonstration on what was achieved so far regarding OSSCs sensitivity, solution-processed ZTO TFTs required to build amplifying unit of PLA structure and STA structures using polycrystalline Organic Semiconductors.

### OSSCs sensitivity

OSSCs measurements under X-ray radiation at different dose rates indicate how the electrode area and geometry play a key role on the device sensitivity. Reproducible and relevant sensitivity values (24nC/Gy) have been measured at voltages of as low as 10V.



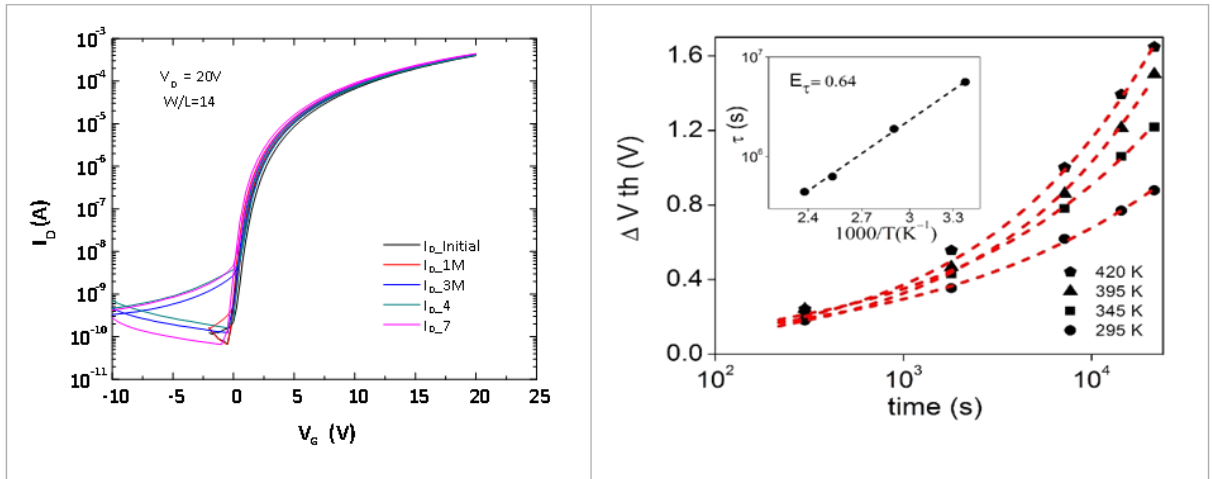
Bias (V)	Sensitivity (nC/Gy)		
	@10V	@50V	@100V
Planar	7	18	28
Vertical	24	49	70

## Solution processed ZTO TFTs, 350 °C annealing, for amplifying unit of PLA structure

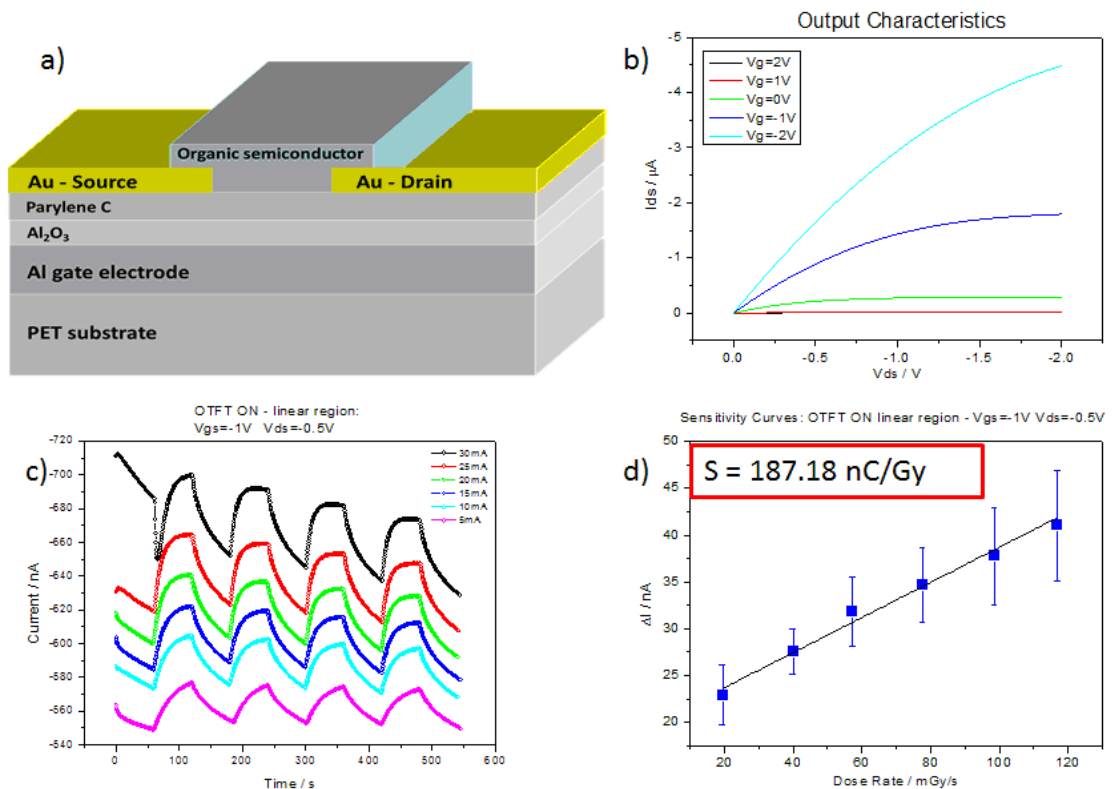
- $V_{on} = -0.5$  V,  $\mu_{sat} = 3.5$  cm<sup>2</sup>/V<sub>s</sub>,  $S = 0.35$  V/dec, On/Off > 10<sup>6</sup>
- No significant variation after 7 months of idle-shelf life

Under positive gate bias stress:

- $\Delta V_T$  fitted by stretched exponential equation, in agreement with charge trapping model.
- $\Delta V_T$  saturates in 10<sup>4-5</sup> s and is fully recoverable in 1h at 300 K.
- Thermally activated  $\Delta V_T$ ;  $E_T = 0.64$  eV related to SiO<sub>2</sub>, not with intrinsic defects in ZTO.



## Organic transistor in STA structure

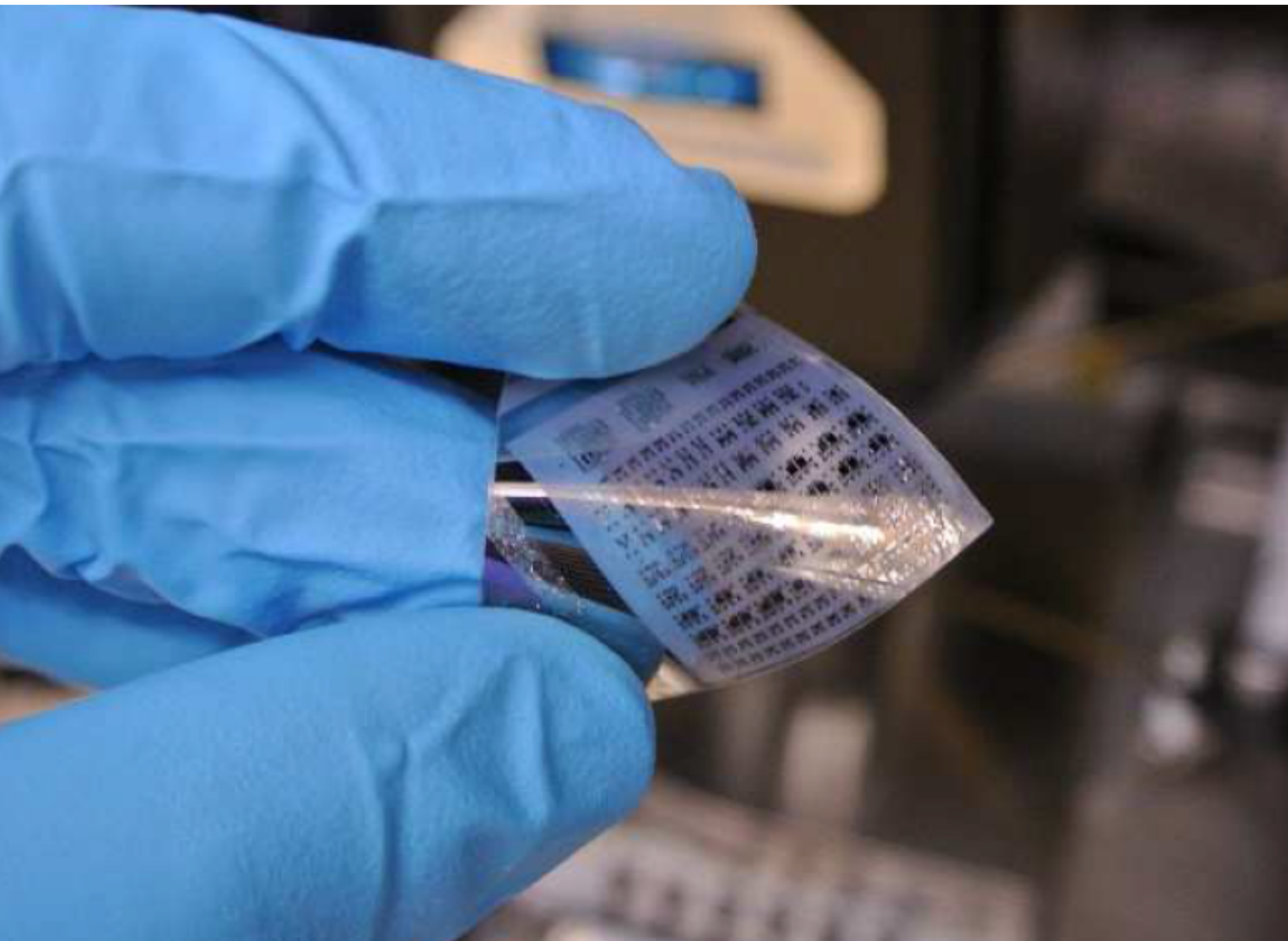


- All devices can be operated at very low voltages and showed a marked response under x-Rays
- The response vs dose rate is reproducible and linear
- $\Delta I$  increases with the applied gate voltage
- Very high sensitivity up to 187 nC/Gy

## 1.2 Deliverables

10 new deliverables were submitted between month 12 and 18:

- **D2.1** – Report on best performing free standing OSSCs (M12)
- **D2.2** – Report on the best performing OSSCs/substrates and/or OSSCs/electrodes combinations (M18)
- **D3.1** – Report on the implementation and characterization of high performance amplifier unit (M15)
- **D3.2** – Report on the implementation and characterization of the PLA structure (M18)
- **D4.2** – Delivery of the PLA and STA TDK (M18)
- **D5.1** – Report on the radiation hardness and of the degradation assessment of each i-FLEXIS component (M18)
- **D6.1** – Identification of the “LEGO” building blocks structure needed for each specific application (M18)
- **D7.3b** – Plan for using and disseminating foreground, including information on website access (M18, update from M9)
- **D7.4** – Report on raising public participation and awareness (M16)
- **D7.8b** – Plan for the exploitation of the results and its upgrade (M18, update from M9)



## 2. MEETINGS

Main outcomes from 3<sup>rd</sup> and 4<sup>th</sup> GA, announcements for 5<sup>th</sup> GA and 2<sup>nd</sup> review meeting.

### 3<sup>rd</sup> General Assembly, October 2014

The 3<sup>rd</sup> general assembly was held in Cagliari, Italy, during October 23<sup>rd</sup> and 24<sup>th</sup> 2014. It was hosted in the Department of Electrical and Electronic Engineering of the University of Cagliari.

All the foreseen deliverables have been submitted and lively fruitful discussions took place during the meeting between partners, as we are all growing more and more actively involved in collaborative research activities within the project. As major outcomes of this meeting, OSSCs synthesis routes were restricted to the best performing crystals. Encapsulation of the different components was also discussed and routes allowing for simple and low-cost processing were presented, allowing for instance a significant electrical stability improvement of oxide electronics. Structure, topics and organization of the 1<sup>st</sup> workshop and spring schools of the i-FLEXIS project were defined.



### 4<sup>th</sup> General Assembly, March 2015

The 4<sup>th</sup> general assembly was held in Zurich, Switzerland, during March 12<sup>th</sup> and 13<sup>th</sup> 2015, hosted by Nanograde at the Uto Kulm hotel. All the foreseen deliverables have been submitted and the Consortium is rapidly moving to the realization and characterization of fully printed X-ray sensors. In fact, the project was considered to be in a stage where all the required components of the i-FLEXIS system start to be available. Hence, even if further optimization of these components will continue during the next months (e.g., printable OSSCs, solution processed oxide TFTs) a strong effort is now being devoted to circuit design/simulation and initial integration experiments.



### Upcoming meetings

The 5<sup>th</sup> GA will take place in Trieste on October 2015 and the 2<sup>nd</sup> review meeting on May 27-28<sup>th</sup> 2015 in Brussels. Our next newsletter, out in September 2015, will describe main conclusions from this 2<sup>nd</sup> review meeting.

# 3. WORKSHOPS AND SCHOOLS

## 1<sup>st</sup> i-FLEXIS Workshop and Spring School at E-MRS Spring 2015

Having in mind the large audience and the broad range of research fields covered by E-MRS Spring Meetings, this year's event, between May 11<sup>th</sup>-15<sup>th</sup> 2015 in Lille, will also host the 1<sup>st</sup> workshop and the 1<sup>st</sup> spring school of i-FLEXIS.

More information on these events can be found at

<http://www.emrs-strasbourg.com/index.php>

and <http://www.iflexis.eu/index.html>

### 1<sup>st</sup> i-FLEXIS workshop

The workshop will be in the form of a symposium entitled “**Organic Semiconducting Single Crystals: from fundamentals to advanced devices**”

#### **Hot topics to be covered:**

- novel materials synthesis
- OSSCs growth (vapour, solution, epitaxial methods)
- defects and electronic charge traps
- crystalline nanostructures
- optical properties (PL, FTIR, CL, photoconductivity, absorption, etc)
- structural characterization (XRD, AFM)
- surfaces and interfaces (XPS, SKP, UPS, STM)
- fundamentals of charge and exciton dynamics
- device patterning and fabrication
- characterization of bulk and interfacial properties at various length scales
- electrical transport properties (theory, modelling and experiment)
- electronics, optoelectronics and sensing applications

Selected papers from the symposium will be published in special issue of the journal *Advanced Functional Materials* (Wiley), entitled “Organic Semiconducting Single Crystals: from fundamentals to advanced devices”.

### 1<sup>st</sup> i-FLEXIS spring school on “Flexible Electronic Sensors”

The spring school will be held in May 15<sup>th</sup>, between 9 am and 3 pm. It aims 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 some external invited speakers will cover topics ranging from materials and devices to fabrication and applications.

The school welcomes attendees who are new to the topic as well as researchers who may not be fully aware of some of the new materials, techniques and devices available. This **school is open to the all E-MRS participants upon registration**, by completing the online form found at [http://www.emrs-strasbourg.com/files/i-flexis\\_spring\\_15\\_tutorial\\_form.doc](http://www.emrs-strasbourg.com/files/i-flexis_spring_15_tutorial_form.doc)

A booklet with the abstracts of the presentations will be offered to the attendees.

**Selected papers will be published in special issue of the journal *Sensors*, entitled “Flexible electronic sensors”.**

### ORGANIZERS

Beatrice Fraboni  
Alessandro Morgera  
Yves Geerts  
Alberto Morpurgo  
Vitaly Podzorov

## 4. TRAINING ACTIVITIES

### Student and researcher exchange program

Continuing the vision of promoting a multidisciplinary education within EU-funded projects, exchange programs between researchers and students from the different partners continue to take place. As an example, two MSc thesis are currently being prepared under a student exchange program between UNIBO and UNOVA, on the fabrication of oxide TFTs with different multilayer dielectrics and on the radiation hardness of oxide and organic TFTs. Exchange program occurring during the last 6 months are listed below.

1 – UNOVA TO UNIBO (January-June 2015): effects of strong radiation fields onto high mobility oxide transistors.

2 – UNIBO to UNOVA (January-April 2015): fabrication of dedicated device layouts for studying the X-ray-high-mobility oxide interaction and the role of the dielectrics

3 – UNIBO to ERAD (February 2015): comparison and calibration of the X-ray sensing performance of OSSC detectors with standard inorganic ones (Si and CdTe)

4 – BIOAGE to UNIBO (February 2015): development of a dedicated readout electronic for the 2x2 matrix demo for the HD sensors , based on inorganic electronics.

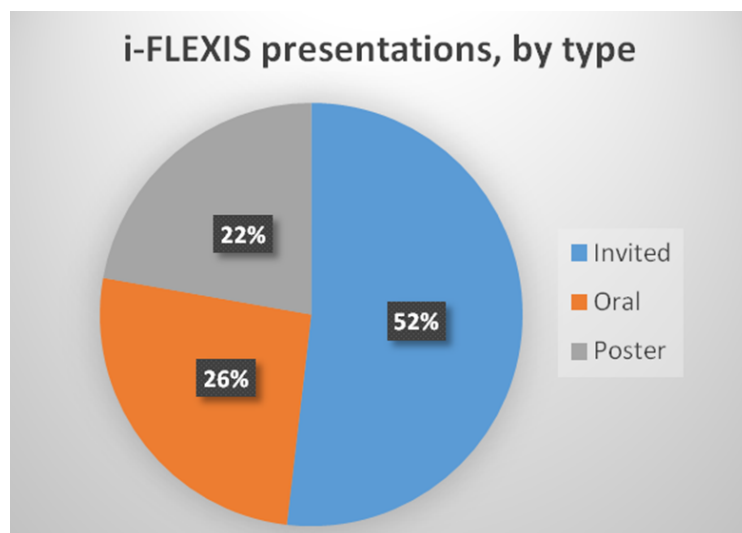
5 – UNICA to UNIBO (January 2015): development and tests of inkjetted TIPS PLA structures

6 – UNITS to UNICA (February–March 2015): development and optimization of the inkjet processes targeting larger and thicker printed crystals

## 5. DISSEMINATION

### Overview on participation in conferences, articles and training

Being such a multidisciplinary project, topics such as OSSCs processing and characterization, organic and oxide TFTs, and radiation detectors have been intensively disseminated by i-FLEXIS partners. Since the beginning of the project **27 presentations** have been given in international scientific conferences in Europe, Asia and USA, being more than half of them invited



contributions. This clearly demonstrates the relevance of the topics and the recognition of the scientific community regarding the excellence of the work developed within i-FLEXIS.

At this stage of the project results start to be consolidated and scientific articles are thus being published. Until January 2015, a total of **9 articles in prestigious journals** such as Faraday Discussions, Journal of Applied Physics and IEEE Electron Device Letters, as well as one book chapter have been published. A complete list of these publications can be found at i-FLEXIS website.