COSMIC enters the second project phase on complementary organic circuits

On July 7th, 2011 the consortium of the European project COSMIC meets at the ST Microelectronics facility site in Catania. Within 18 month major improvements on p- and n-type organic transistors have been achieved, which are now the basis for the second phase of COSMIC, where both transistor types should be integrated to complementary organic transistor logic gates and circuits. The challenge in COSMIC is to reach a stable and robust manufacturing process on plastic film substrates, where different manufacturing platforms – including carrier based approaches for highly complex circuits as well as sheet and roll processing for large area or high-volume applications – are addressed. In the foreground of the project is mainly not to push individual transistors to the limits of organic electronics, but to get reproducible performance with low variation and tolerances. This is the pre-condition for reliable device modeling and to establish a trustworthy design environment for organic circuit integration.

The first year of the project revealed that it is really a big challenge to control all the processing parameters and environmental influences in a low-cost organic electronic approach. Measurements on process evaluation modules showed different problems in device performance like inadequate threshold voltages, hysteresis in TFT switching behavior, contact resistances or device stability. In general p-devices are more advanced than n-devices, which may have also some reasons in the development status and reproducibility of the supplied materials. However, since mobility matching plays a crucial role in complementary circuits, the improvement of the n-semiconductor is an important issue for COSMIC.

Still there are problems to solve to bring the transistor characteristic in a region acceptable for circuit integration. Especially threshold voltage variation less than ±3 Volts are still hard to keep. But rather good results for transistor performance are already obtained with present leading-edge semiconductors offering carrier mobility of up to 1 cm^2/Vs.

From a manufacturing view another large challenge is the variation in oTFTs characteristics, which still has to be improved. These deviations from nominal values can be caused by many parameters, like materials, interface properties and deposition conditions. Measures like increasing substrate surface quality, surface conditioning with SAMs, defect free deposition of dielectrics, reducing of “coffee-staining” and so on have been investigated to improve the performance in terms of reproducibility and uniformity. Also development of p-type semiconductor by the project partner Flexink turns out to support the demands with respect to processing robustness.

Overall the technological basis has improved so far that the next development phase for circuit integration can be entered and a good basis to enable the ambitious applications selected for demonstration of the technology can be reached.

Contact COSMIC at
Plastic Electronics Europe 2011
11.-13. October 2011, Dresden

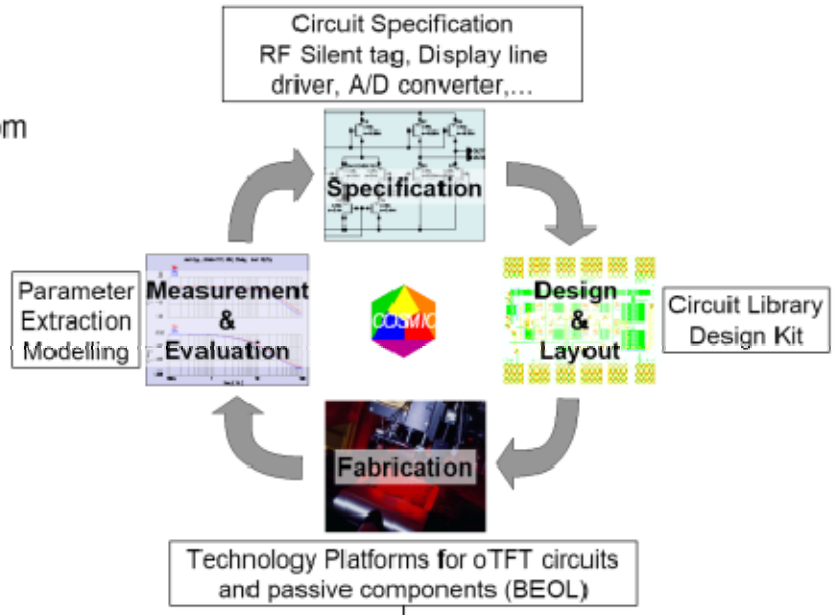
Photo from the COSMIC project partners meeting at the ST Microelectronics facility in Catania

Persons from left:
Anis Daami, Eugenio Cantatore, Warren Duffy, Tung-Huei Ke, Lidia Madionna, Luigi Mariucci, Christian Kiesl, Isabelle Chartier, Waqas Syed, Kornelius Tetzner, Sahel Abdinja, Gerhard Klink, Salvatore Abbisso, Matteo Rappisarda, Antonino Scuderi, Humberto Moran, Francesca Tramontana, Martin van Neer, Giorgio Maiellaro, Giuseppe Papotto

For more information see
www.project-cosmic.eu

The collaborative project COSMIC

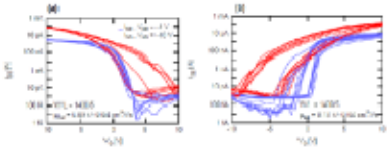
- generates a technology platform for organic electronics
- covers organic electronic applications from flexible complex, large-area to low-cost circuits
- targets complementary organic thin film transistor logic with p- and n-type oTFTs
- addresses the chain from design to manufacturing level
- optimizes process robustness to increase integration density
- sets up circuit modelling and design libraries
- includes digital and analog circuits as well as passive components
- will demonstrate technology with major lead applications



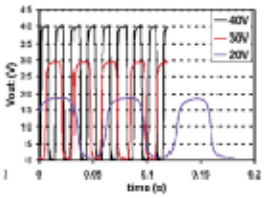
Foil on Carrier (W2W)
Ø150 mm foil on carrier
Clean room
Complex organic circuits

Sheet to Sheet (S2S)
320x380 mm sheets
Printing processes
Large area circuits

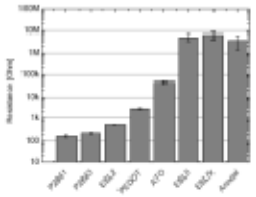
Roll to Roll (R2R)
210mm web
inline processes
Low-cost circuits



Statistics on p- and n-type oTFTs



Oscillation of ring oscillator with complementary inverters



Resistors printed with different carbon pastes

Project partners:
Fraunhofer EMFT (D)
CEA (F)
ST Microelectronics (I)
TNO (NL)
TU Eindhoven (NL)
IMEC (B)
Università di Catania (I)
CNR (I)
TU Berlin (D)
Friendly Technologies Ltd. (UK)
Flexink Ltd. (UK)
PolymerVision B.V. (NL)

Duration:
1.1.2010 - 31.12.2013

Coordinator:
Prof. Karlheinz Bock,
Fraunhofer EMFT

Internet: **www.project-cosmic.eu**