IEEE-EDS Mini-Colloquium (MQ) on Flexible Electronics

Tarragona, Spain July 11 2019

Sala de Juntes, Campus Catalunya, Avda. Catalunya 35

Time	DL	Title
10:30 – 11:00	Registration	
10:30 – 11:00	Refreshments	
10:50 – 11:00	Benjamin Iñiguez (ED Spain Chair)	**Introduction**
11:00 – 12:00	Joachim Burghartz (IMS Chips, Germany)	**Ultra-Thin Si Chips - A New Paradigm in Silicon Technology**
12:00 - 13:00	Arokia Nathan (Cambridge Touch Technologies, UK)	**Transparent and Flexible Nano-Electronics for Organic Displays and Ultralow Power Sensor Interfaces**
13:00 - 14:30		**Lunch**
14:30 - 15:30	Magali Estrada (CINVESTAV, Mexico)	**Fabrication Issues of Amorphous Oxide Semiconductor Thin Film Devices**
15:30 - 16:30	Lluís F. Marsal (URV, Spain)	**Current progress and future perspectives in polymer solar cells**

With the collaboration of: Diputació Tarragona

"Ultra-thin Chips - a New Paradigm in Silicon Technology"

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Abstract:
Flexible electronics add mechanical flexib ility, adaptivity and stretchability as well as large-area placeability to el ectronic systems, thus allowing for conquering fundamentally new markets in consumer and commercial applications. Hybrid assembly of large-area devices a nd ultra-thin silicon chips on flexible substrates is now viewed as an enabler to high-performance and reliable industrial solutions as well as high-end consumer applications of flexible electronics. This talk discusses issues in ul tra-thin chip fabrication, device modeling and circuit design, as well as assembly and interconnects for thin chips embedded in foil substrates . Numerous distinct differences to conventional silicon technology justif y the statement that ultra-thin chips features a new paradigm in silicon technology.

Transparent and Flexible Nano-Electronics for Organic Displays and Ultralow Power Sensor Interfaces

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Abstract

Oxide semiconductors are a new generation of semiconductors for display electronics in view of their high transparency, low temperature processing, and low fabrication cost. Considerable progress has been made in designing large area transparent systems using this materials system. Part of this talk will address the design approaches employed for operationally stable organic light emitting displays. In particular, the quest for low power becomes highly compelling. We will discuss transistor operation in the different regimes, and review device properties when operated in the deep sub-threshold regime or in near-OFF state, addressing the pivotal requirement of low supply voltage and ultralow power leading to potentially battery-less operation.

Fabrication Issues of Amorphous Oxide Semiconductor Thin Film Devices

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Abstract

Due to the relatively high electron mobility, high optical transparency, low temperature and relatively low cost processing techniques, amorphous oxide semiconductor thin film transistors (AOSTFTs) have found important applications and are object of intensive research on technological and physical aspects, looking to improve stability, increase mobility and reduce operating voltage range, among other aspects.

In this presentation, we will talk on the fabrication process of high mobility, low operating voltage and low temperature processed AOSTFTs, where the semiconductor layer is Hf-In-Zn-O and the insulator HfO2 (HIZO/HfO2 TFTs), using spin-coated polymethyl-methacrylate (PMMA) as passivation and etch-stop layer (ESL). With the exception of the PMMA, all layers are deposited by RF sputtering and processing temperatures does not exceed 200 oC.

We describe variations in the technological process to significantly increase mobility, well above the typical values of 5-15 cm2/Vs reported for devices using In-Ga-Zn-O as semiconductor layer and SiO2 as insulator, as well as to reduce the operating voltage regime from 10 V to less than 2 V.

The results of characterization of the fabricated devices is analyzed. Special attention is focused to the significant increase in mobility that can be obtained, reaching values even above 300 cm2/Vs. This increase seems to be possible due to the specifics of the conduction mechanism in AOSTFTs, which can includes not only multiple trapping and release mechanism but also band percolation and band conduction mechanisms. Depending on the specific device characteristics associated to the fabrication process, or depending on the operation regime for the same device, the predominant mechanism can be one of the above mentioned.

Current progress and future perspectives in polymer solar cells

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Polymer solar cells are considered as a promising renewable energy source because of their light-weight, high transparency, possibility of fabrication in large areas and inexpensive solar energy production. These solar cells are based in the junction of two different organic semiconducting materials, one donor and one acceptor. The most efficient devices to date are the bulk heterojunction cells, obtained from a mixture of the donor and acceptor materials, which provides an enormous interfacial surface.

In the last years, advances in polymer-based organic solar cells have been possible due to different approaches such as design of new structures and synthesis of new materials such as small molecule and polymers with low band-gaps, control of the nanoscale morphology, new interfacial transport layers, variation of the ratio of the donor/acceptor in the bulk heterojunction, application of thermal or solvent annealing process, among others [1-4]. As a result, in the last years, power conversion efficiencies over 12% are obtained. However, there are still some problems to solve such as the stability and degradation process of the polymeric solar cells. In this lecture, we will detail the perspectives and recent advances made in polymer solar cells, design and synthesis of new polymers and in particular the active layer morphology, interfacial layers and stability. We will also discuss the basic device operation and various parameters limiting their efficiency and their possible solutions.

References:

[1] P.L. Han, A. Viterisi, J. Ferre-Borrull, J. Pallarés, L.F. Marsal, Organic Electronics: physics, materials, applications, 41, 229-236 (2017)

[2] E. Osorio, J.G. Sánchez, L.N. Acquaroli, M. Pacio, J. Ferré-Borrull, J. Pallarès, and L.F. Marsal, ACS Omega, 2, 3091−3097 (2017)

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[4] Victor S Balderrama, José G Sánchez, Gonzalo Lastra, Werther Cambarau, Saúl Arias, Josep Pallarès, Emilio Palomares, Magali Estrada, Lluis F Marsal, Journal Materials Chemistry A, 6, 22534-22544 (2018)