VIRTUAL MINI-COLLOQIUM ON TFT FOR EMERGING TECHNOLOGIES

Chairs: Benjamin Iñiguez and Arokia Nathan

Organizers:

IEEE Electron Devices Society

ED UK and Spain Chapters

University of Cambridge (UK)

University Rovira i Virgili, Tarragona (Spain)

2nd September 2021

Programme (times in GMT+1)

8:55-9:00

Mini-Colloquium Opening
Benjamin Iñiguez
University Rovira i Virgili (Spain)

9:00-8:25

Takayuki Ikeda
Semiconductor Energy Laboratory Co., Ltd. 398 Hase, Atsugi-shi, Kanagawa, Japan
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"Circuit design with crystalline oxide semiconductors"

Abstract

Oxide semiconductors have been widely used for display backplanes. Research on the crystallinity of oxide semiconductors and work that explores the use of oxide semiconductors in scaled transistors for ICs have also been reported in recent years. Oxide semiconductor field effect transistors (OSFETs) enjoy the advantages of being monolithically stackable over Si CMOS devices, low in off-state current, and relatively high in breakdown voltage, and having good saturation characteristics and relatively wide subthreshold regions. These features of OSFETs extend their application beyond displays into ICs. Meanwhile, circuit design with OSFETs is different from circuit design with only Si FETs. One of the differences is that an OSFET has a back gate that

can be controlled independently of the top gate. In this presentation, I will provide an overview of oxide semiconductor technology, and discuss circuit design that takes advantage of unique features of OSFETs.

9:25-9:50

Yanli Pei, Haofeng Rong, Peng Yang, Guangshuo Cai
State Key Lab of Optoelectronics Materials & Technologies, School of Electronics and Information Technology, Sun Yat-Sen University, Guangzhou 510006, People's Republic of China
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"Biosensor based on In2O3 thin film transistor"

9:50-10:15

Zhongyi Zhou[1] , Huimin L[i1] , Xinghui Liu[2] , Kai Wang1, *
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[2] Shenzhen Chipwey Innovation Technologies Co., Ltd, Shenzhen, China
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"IGZO TFT-based Addressing and Readout Circuits for Hybrid LAE-CMOS Interfacing"

10:15-10:40

D. Wang[1], S. Shi[2], P.Zhou[2], C.Chen[2], and H. Ma[1]
[1]Suzhou Institute of Biomedical Engineering and Technology, Chinese Academy of Sciences, Suzhou, China
[2]Guangdong ACXEL Micro & Nano Tech Co., Ltd., Foshan, China
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"Active matrix digital microfluidics chip with diversified pixel designs "

10:40-11:05

Paul R. Berger[1,2]
EDS Distinguished Lecturer
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[2] Tampere University, Department of Electronics and Communications Engineering, Printed and Organic Electronics Group, Tampere, Finland
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"Fully Printed Flexible Electronics: Low Voltage TFTs and Novel NDR devices"

Abstract

It has been predicted that by 2021, there will be 200 billion connected devices which should all operate and integrate smoothly with the Internet but also provide a vast spectrum of services in e.g. healthcare, smart homes, industry automation, and environmental monitoring. As the "Internet of Things" (IoT) or "Internet of Everything" (IoE) continues to grow, the number of connected objects will grow at explosive rates. For this to be possible, a paradigm shift from current approaches based on rigid silicon CMOS where batteries are used will be required. In the future, IoT objects will have to be extremely low cost, flexible and thin (and in some cases also stretchable) in order for these ubiquitous electronics to be unobtrusive. In addition, these distributed devices must harvest their energy from other means than batteries, as massive numbers of batteries mean massive end of life, toxic waste disposal and recycling issues. Because they will be manufactured by low temperature, low cost mass manufacturing processes, they will be ultra-low cost and able to be put on thin, flexible carriers that make them able to be truly put anywhere.
This talk will place emphasis upon low-voltage thin film transistors (TFT) with threshold voltages below 1 volt and mobilities in excess of 1 $cm^2/V{\cdot}sec$; and a new class of polymer tunnel diodes that manifest with a room temperature negative differential resistance (NDR), enabling hybrid TD-TFT circuits.

11:05-11:30

Luisa Petti, Niko Münzenrieder and Giuseppe Cantarella
Faculty of Science and Technology, Free University of Bozen-Bolzano, Bozen-Bolzano, Italy, 39100
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"Flexible Amorphous Oxide Thin-Film Transistors for Analog Circuits and Systems"

11:30-11:55

Benjamin Iñiguez
EDS Distinguished Lecturer
Department of Electronic, Electrical and Automatic Control Engineering

University Rovira i Virgili, Tarragona (Spain)
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"Compact DC and AC a-Si:H TFT modeling including parasitic capacitances"

Abstract

A new compact model for the drain current and capacitances of a-Si:H TFTs is presented. The model considers both the deep and tail states regions of operations, which dominate in the subthreshold and above thershold regimes, respectively. The model parameters were extracted independently in the two regions using theso-called Unified Model and extraction Method (UMEM) adapted to a-Si:H TFTs. The subthreshod regime and series resistances are adequately taken into account in the DC modeling. regarding the AC operation it was found that the bias dependent parasitic capacitances play a dominant role.

11:55-13:15

Break

13:15-13:40

Arokia Nathan
EDS Distinguished Lecturer
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"Thin Film Transistor Architectures for Advanced Signal Processing"

Abstract

Wide bandgap semiconductors are an attractive materials platform for thin film transistors in active-matrix arrays and sensor interfaces in view of their high transparency and low OFF-current. The thin film transistor continues to evolve, producing devices with higher mobility, steeper sub-threshold slope and lower threshold voltage. However, practical signal processing circuits are constrained by issues related to non-uniformity, electrically- and illumination-induced instability, and temperature dependence. This lecture will discuss the critical design considerations of displays, sensors and sensor interfaces, along with advanced signal processing architectures to show how device-circuit interactions should be handled and how compensation methods can be implemented.

13:40-14:05

Ravinder Dahiya
Sensor Council Distinguished Lecturer
Department of Electronic & Nanoscale Engineering

University of Glasgow, UK
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"Soft Electronic Skin for Robotics"

Abstract

The miniaturization led advances in electronics over last half a century have revolutionized computing and communication. Recent advances in the field are propelled by applications such as conformable electronic skin (e-Skin) that require electronics, sensors, and actuators embedded in soft and squishy materials. These requirements call for new methods for realization of distributed sensing, actuation, and computing on large area and unconventional substrates such as plastic, paper and elastomers. This work will present the approaches in this direction. These range from distributed off-the-shelf devices embedded in soft materials or integrated on flexible printed circuit boards, to using printed nanowires based ultra-thin electronic layers, graphene, and ultra-thin chips, etc. The technology behind such sensitive flexible and squishy electronic systems is also the key enabler for advances in emerging fields such as wearables, and health monitoring technologies etc. This lecture will briefly discuss these advances and the future directions.

14:05-14:30

John Kymissis
EDS Distinguished Lecturer
Electrical Engineering Faculty
Columbia University
New York City, NY, USA
"The impact of contact selection on performance in organic FETs"

Abstract

Organic FETs are a promising technology for next generation electronic systems. Transistors have nearly universally used gold contacts, however, which offers a number of limitations in performance and compliance with environmental and conflict mineral limitations.

Three issues will be discussed in some detail; the challenges associated with metal contact architectures in organic FETs, the advantages of gold and methods for substituting gold with other metals, and approaches to non-metal contact integration. The use of non-metal contacts will also be discussed and in particular, the advantage of using organic conductors as contacts in next generation radiation sensors will be presented.
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14:30-14:55

Sanjiv Sambandan
Department of Engineering
University of Cambridge, UK

14:55-15:20

Jerzy Kanicki
Electrical Engineering and Computer Science Department
University of Michigan
"Electrical Instabilities of Amorphous Metal Oxide Semiconductors"
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15:20-15:45

Samar Saha
EDS Distinguished Lecturer
Prospicient Devices
Milpitas, CA, USA
Department of Electrical, Systems and Computer Engineering, Rensselaer Polytechnic Institute, samarsah@pacbell.net

"Thin Film Transistors for Ubiquitous Flexible Electronics"

Abstract

"Flexible electronics" refers to electronic devices that can be bent, rolled, or folded without losing functionality. This also referred to as the "plastic electronics," "organic electronics or organic and large area electronics (OLAE)," and "printed electronics or printed intelligence." Flexible electronics has an extraordinarily broad range of applications in bendable and stretchable products. These applications include Photovoltaic (PV) panels that conform to curved or otherwise irregular surfaces replacing the conventional heavy and rigid panels for PV electricity generation; OLEDs (organic light-emitting diodes) mounted on curved and bendable surfaces to provide lighting with versatility and energy efficiency than the conventional lighting; flexible displays that are non-breakable, waterproof, rugged, and capable of being rolled up or folded for convenience (transforming smartphones into superior computing platforms by adding larger display that can be rolled up or folded when not in use); sensors embedded in plastic tags for radio frequency identification (RFID), in uniforms and of cloths to monitor impacts on the body, strains on joints, heart rate, blood pressure, and sweat pH; wearable health monitoring devices and medical implants utilizing bendable and stretchable sensors to monitor a wide range of biological functions; smart textiles to create fabrics enable to response to external stimuli – mechanical, thermal, electrical, chemical, or biological; flexible printed devices and sensor on uniforms for defense applications –

electronic readers, communications, displays featuring high-quality photographs, maps, and other information, and communications devices; stretchable electronics – stretchable skin, stretchable electronic fabrics; flexible batteries for powering wearable electronics – wristbands and clothing, slimmer electronics products, and provide a power source for digital smart labels – freshness detectors on food packaging; and so on. Thin Film Transistors (TFTs) have been the mainstream devices for the ever increasing applications of flexible electronics circuits and systems. Thus in this talk, an overview of TFT devices for flexible electronics including basic features, operating principles, fabrication processes, and physics of TFT modeling are discussed. Furthermore, the challenges of TFT devices are highlighted.