Smartkem

OUR TRANSISTORS YOUR ADVANTAGE

MOORE'S LAW & THE DISPLAY INDUSTRY

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These statements may be identified by the use of forward-looking expressions, including, but not limited to, "expect," "anticipate," "believe," "estimate," "potential," "predict," "project," "should," "would," and similar expressions and the negatives of those terms. These statements relate to future events or our financial performance and involve known and unknown risks, uncertainties, and other factors which may cause actual results, performance or achievements to be materially different from any future results, performance or achievements expressed or implied by the forward-looking statements. Such factors include those set forth in the Company's filings with the Securities and Exchange Commission. Prospective investors are cautioned not to place undue reliance on such forward-looking statements, which speak only as of the date of this presentation. The Company undertakes no obligation to publicly update any forward-looking statement, whether as a result of new information, future events or otherwise.

Executive Summary

Reshaping the World of Electronics

SmartKem's TRUFLEX® Disruptive Technology

A revolutionary semiconductor platform for Organic Thin Film Transistors (OTFTs)

TRUFLEX® is a full transistor stack design and process platform that produces transistors that are flexible, bendable, wearable, and lightweight.

Materials are solution deposited on low-cost plastic and glass at a low temperature (80°C) to make transistor circuits with performance significantly beyond amorphous Silicon (aSi).

SmartKem's TRUFLEX® materials are compatible with existing industry standard manufacturing infrastructure and next generation printing processes.

The platform can be used in several applications including mini-LED displays and backplanes, OLED displays, fingerprint sensors, and integrated logic circuits.

World Class Technology Team

41 (11PhDs) full time employees with 200+ combined years industrial and R&D pedigree at ICI, Merck, Philips, Kodak, CDT, Motorola, GlobalFoundries.

Having developed the chemistry, the process, and the design rules, SmartKem is a fab-less company and has outsourced its chemistry scale-up.

Extensive, Broad and Defendable IP Portfolio

133 patents across 16 patent families – 122 granted and 11 pending

37 codified trade secrets

SmartKem has traction

Launched first demonstrator at SID 2020.

In 2021, SmartKem announced a JDA with RiTdisplay to collaborate on the production of a full color demonstration AMOLED display.

In February this year, SmartKem announced a JDA with Nanosys to collaborate on new generation solution printed microLED and quantum dot materials for advanced displays.

Investor Confidence

Reshaping the World of Electronics

In February 2021, SmartKem raised $24.6 million in gross proceeds through a private placement of common stock-only at $2.00 per share.

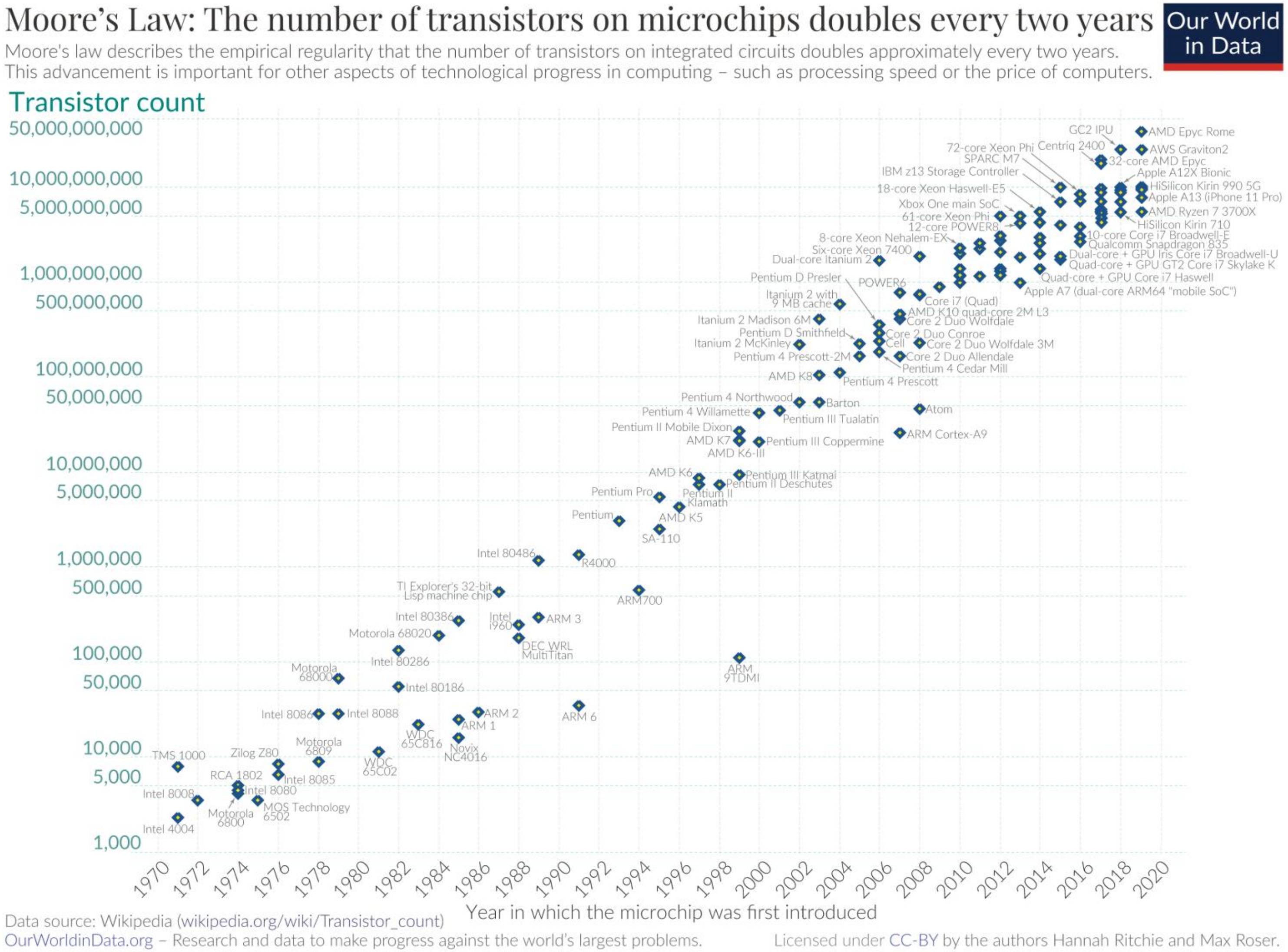
To date, over $60 million has been invested in SmartKem.

Institutional investors include AIGH, Octopus Ventures, Entrepreneurs Fund LP, and BASF Ventures.

Moore’s Law

Moore’s Law is the observation that the number of transistors in a dense integrated circuit (IC) doubles about every two years. It is an observation and projection of an historical trend.

Rather than a law of physics, it is an empirical relationship linked to gains from experience and production.



“Sometimes I sits and thinks,

and sometimes I just sits.”

If silicon transistors are free and we only need a few thousand for a display, why aren’t all backplanes made of silicon?

Large area processing

Parameter	SmartKem OTFT	a-Si	IGZO	LTPS
Current Usage	In development (demonstrated in e-paper, LCD and OLED)	LCD and rigid e-paper	OLED TV and some tablet LCD	Mobile phone (OLED and some LCD)
Typical Charge Mobility in Display Pixel	3 cm^2/Vs	0.5 cm^2/Vs	10 cm^2/Vs	50+ cm^2/Vs
Process Temperature	80 °C*	300 °C	320 °C	350 °C
Substrate Compatibility	Wide range of plastics and glass	Glass	PI/glass	PI/glass
Current Driving Stability	Very Good	Average	Very Good	Excellent
Off Current	Excellent	Average	Excellent	Average
Impact Resistance	Excellent	Poor	Poor	Poor
Bend Radius	0.5mm	4mm	2mm	4mm
Manufacturing Maturity	Prototype	Excellent	Fair	Good
Process Cost	Low	Low	Medium/High	Medium/High

If an IC only needs a small number of transistors then why aren’t they made on display lines?

CMOS inverter logic

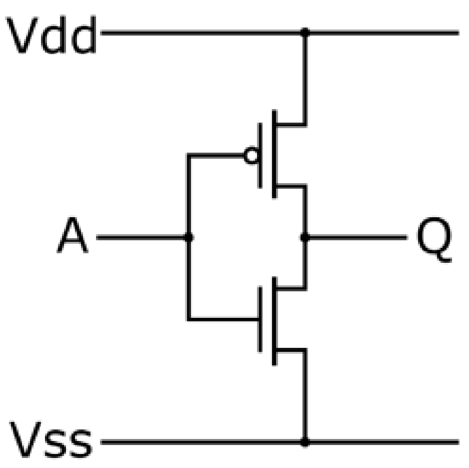
Advantages

- Low power consumption (only have to change charge on gate of TFT) – no resistive loads consuming power.
- Fast switching (if p and n devices are well matched).
- Rail to rail switching with high gain. Large noise margin.

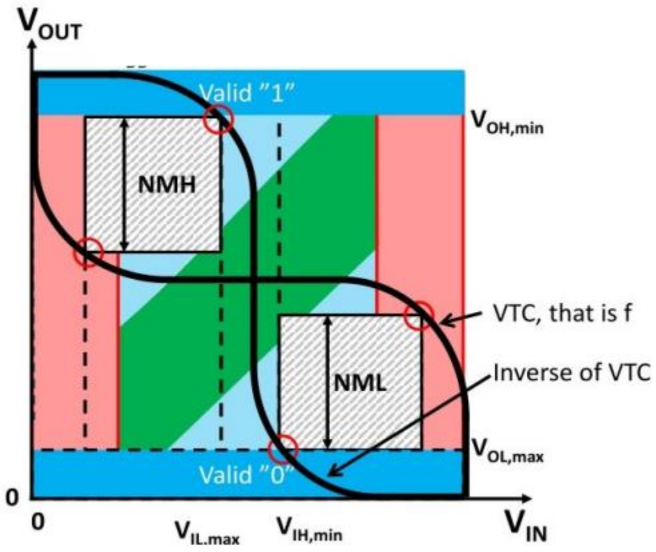
Disadvantages

- Need a greater number of photomasks and processes (to define the p-type and n-type diffused-in regions.

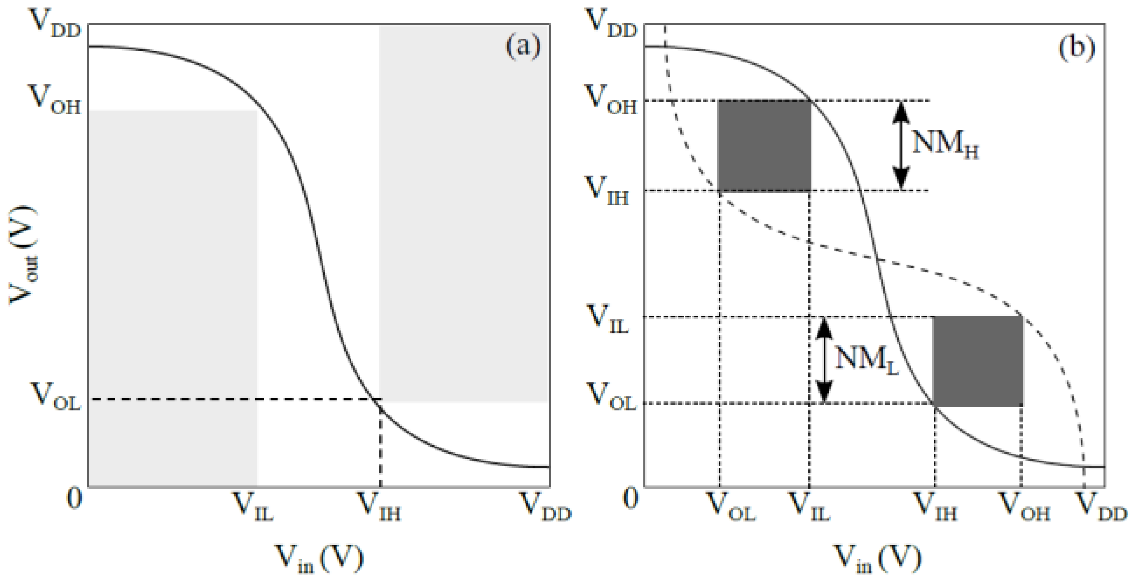
CMOS TFT design uses p and n type TFT with gates connected

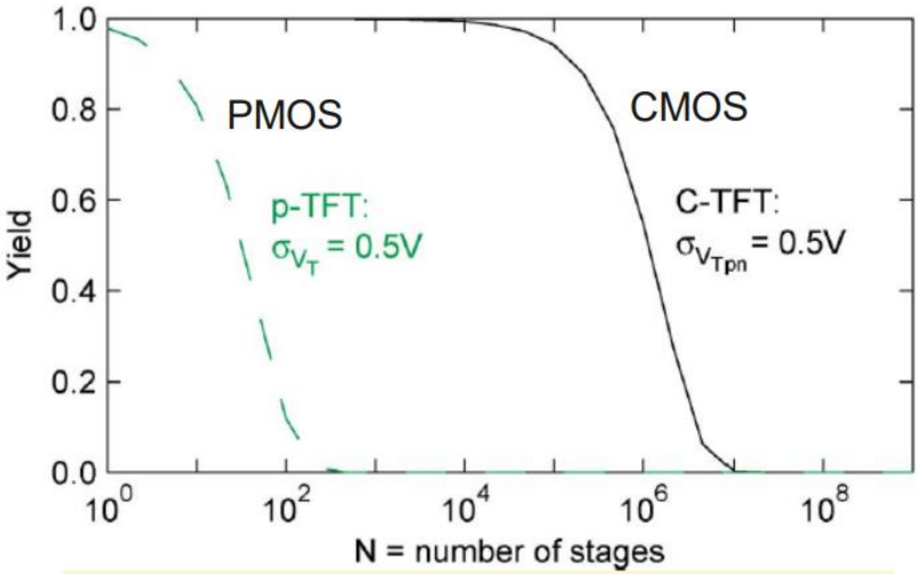


"Butterfly diagram"showing the wide tolerance of the CMOS inverter to variations in device Vth



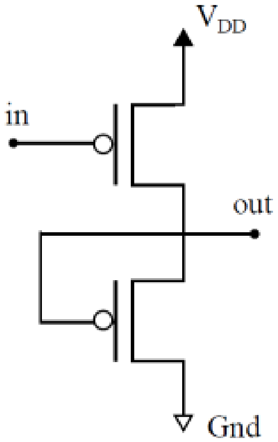
PMOS inverters vs CMOS inverters





D. Bode *et al.*, IEEE Trans. El. Dev **57**, 201 (2010)

- PMOS inverter – a transistor load is used for pull-up and pull-down of the voltage output.
- Noise margin and gain is lower than for CMOS



- Comparing CMOS with PMOS for the same spread of Vth in transistors, CMOS can yield circuits of with 10,000 times more stages

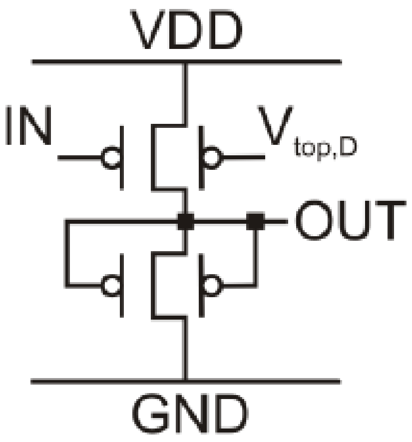
Pseudo CMOS

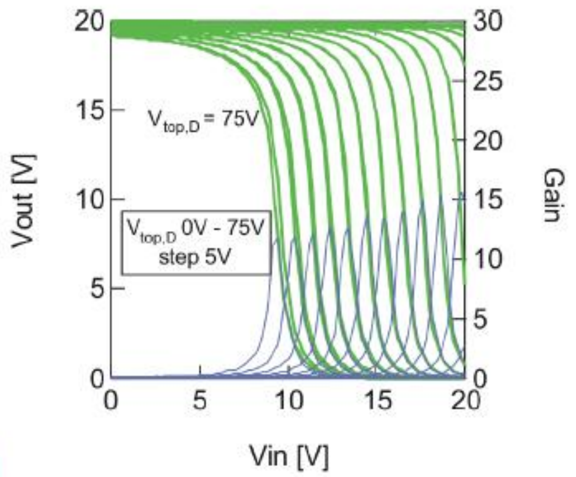
- *Pseudo CMOS* is a term for designs of logic that emulate some of the benefits of CMOS but often use NMOS or PMOS only transistors (hence avoid the processing complexity)
- Pseudo CMOS approach will follow the work of IMEC which showed that it is possible to widen the noise margin of transistors using dual gate OTFT technology to make 2 types of OTFT with different threshold voltages

2010 IEEE International Solid-State Circuits Conference

7.4 Robust Digital Design in Organic Electronics by Dual-Gate Technology

Kris Myny[1,2,3], Monique J. Beenhakkers[3], Nick A. J. M. van Aerle[4], Gerwin H. Gelinck[4], Jan Genoe[1,5], Wim Dehaene[1,2], Paul Heremans[1,2]





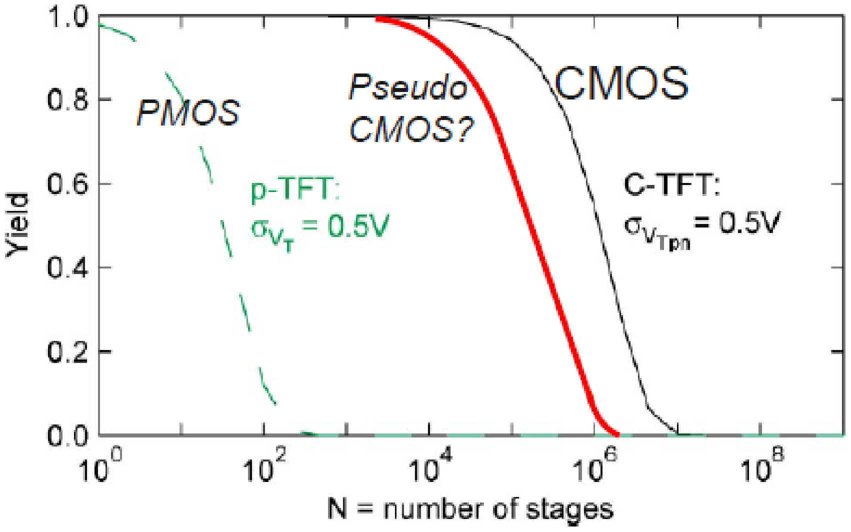
Advantage

- Can integrate many transistors in a circuit without failure due to Vt variations
- Only requires 1 more mask than PMOS only

Disadvantage

- Still uses more power than CMOS due to load TFT

Pseudo CMOS is predicted to achieve similar yield to CMOS in larger circuits



EDA Tools – PDK integrated into Cadence workflow

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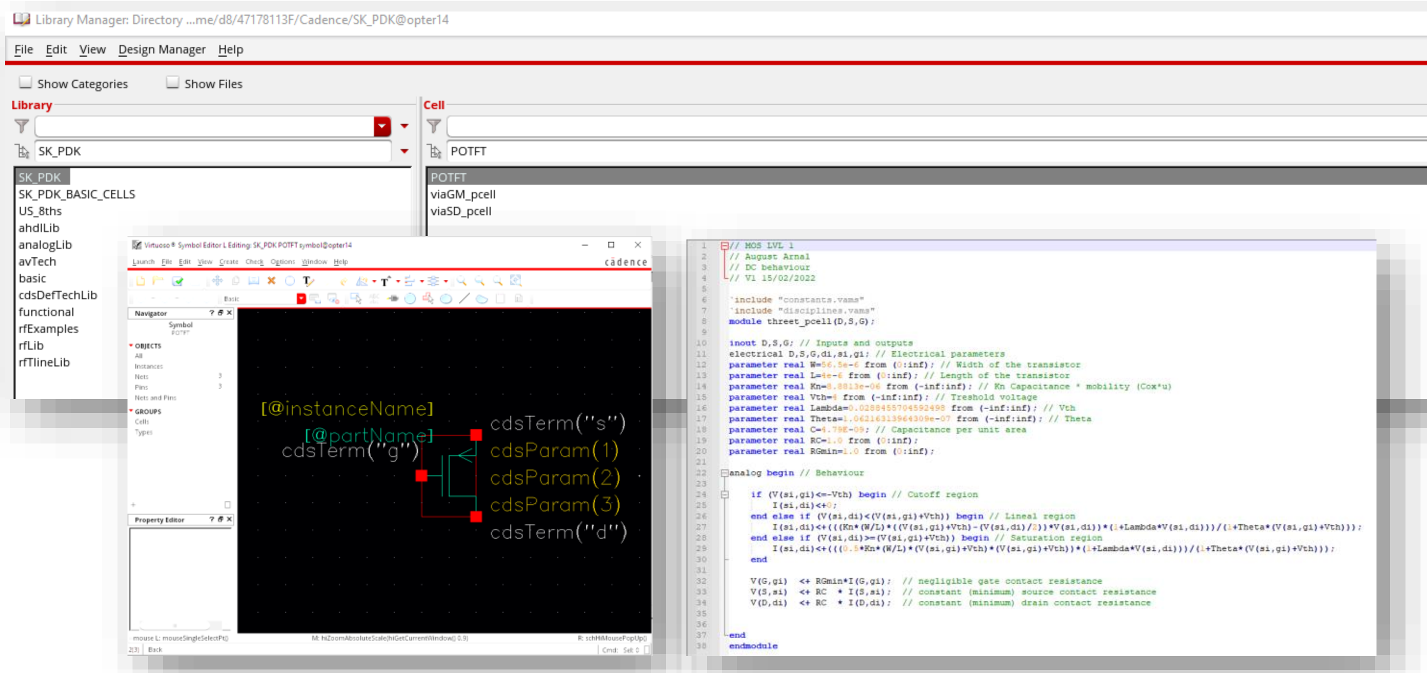
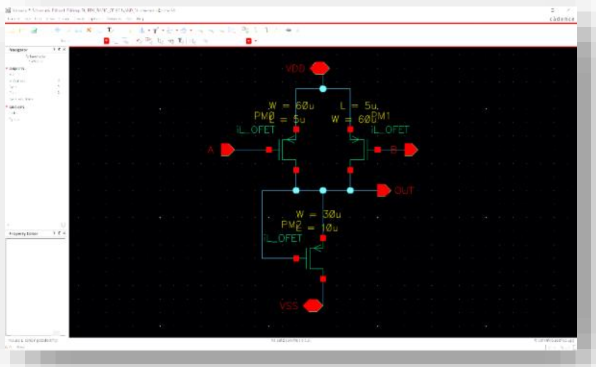
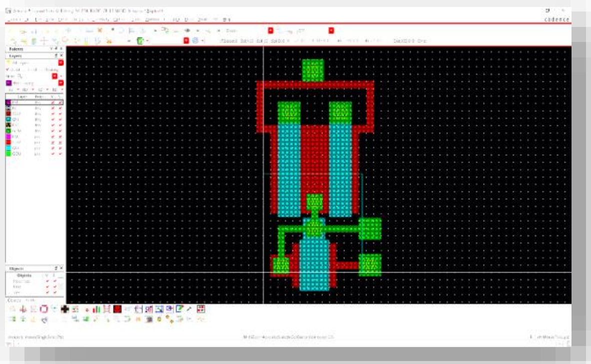
TRUFLEX® Design Tools



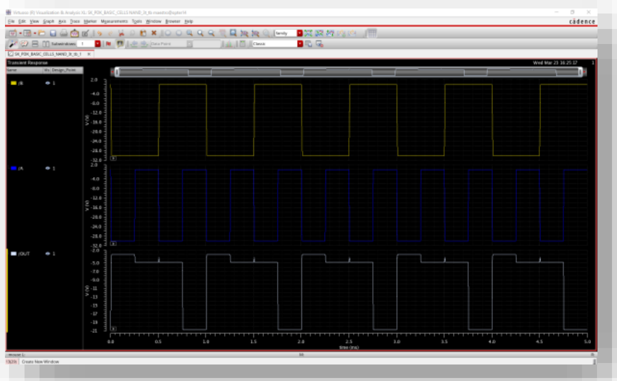
Single gate OTFT layout via p-cell

- Single gate PDK undergoing testing/validation
- Dual gate PDK expected end Q2 2022





NAND layout

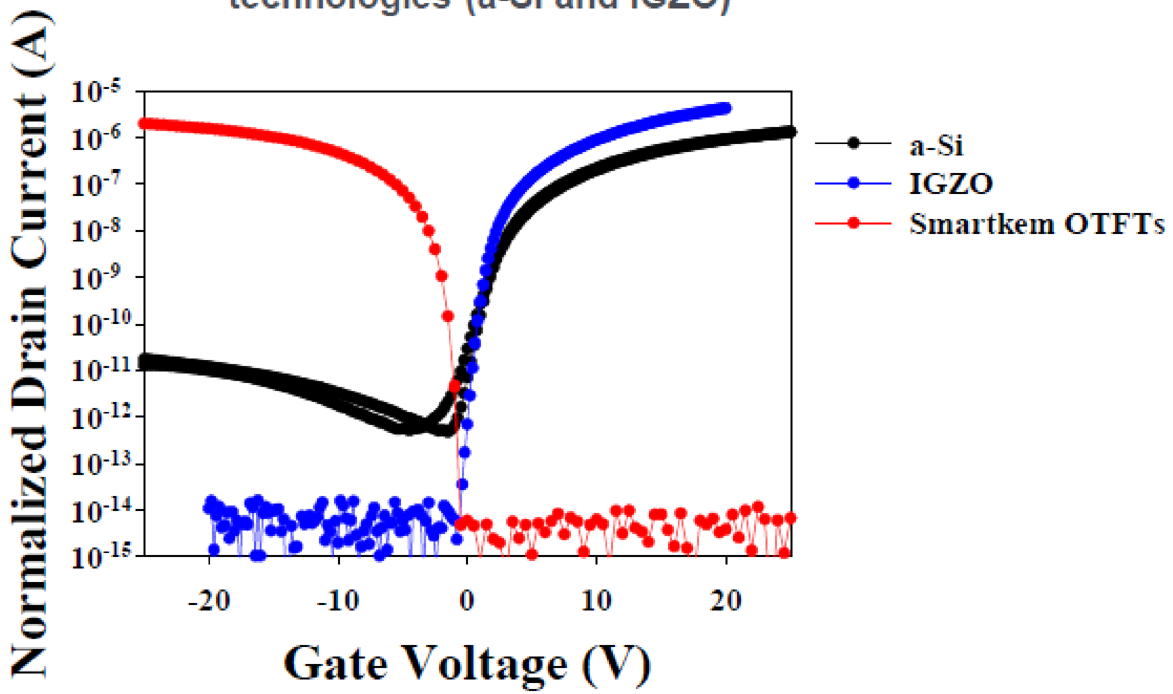


NAND simulation

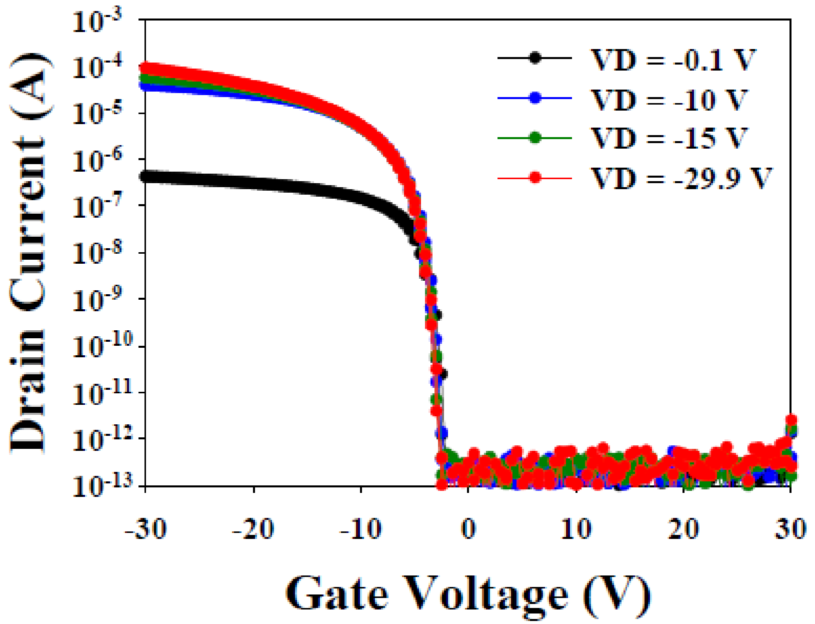
Comparison of TFT characteristics

- OTFTs offer a low-off current level for VGL switch benefits vs a-Si
- OTFT is capable of high voltage stability in driving (for bi-stable display applications)

SmartKem vs. other large area TFT technologies (a-Si and IGZO)



SmartKem Voltage Turn-on Stability

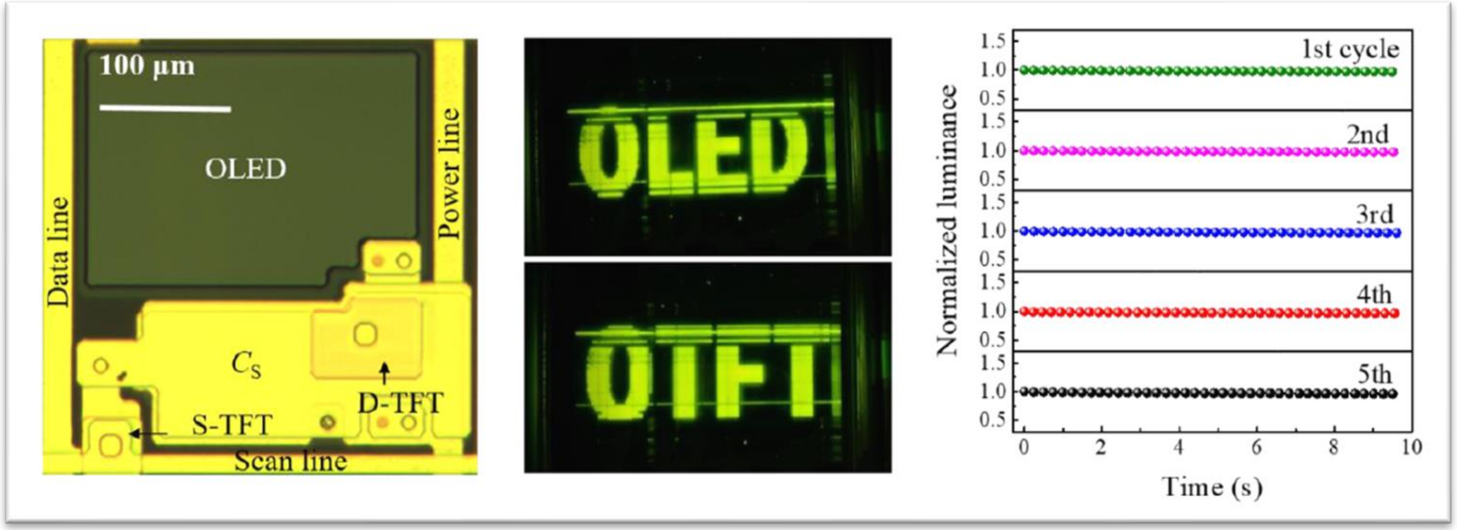


AMOLED USING OTFT

- 4.7" AMOLED made in conjunction with SJTU (Shanghai Jiao Tong University), LinkZill and Visionox (paper in current issue of Advanced Electronic Materials)

- doi.org/10.1002/aelm.202200014

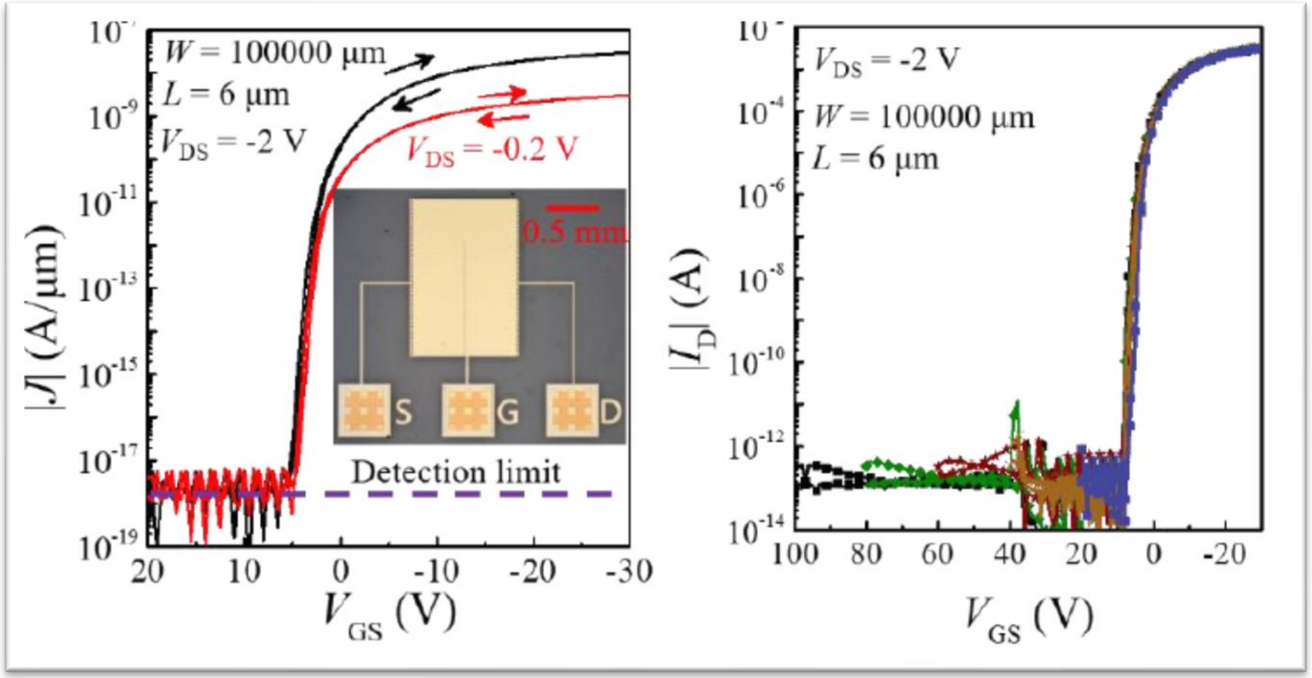
- Ultra-low off current devices mean that the display can be refreshed at 0.1Hz without any not



ADVANCED ELECTRONIC MATERIALS

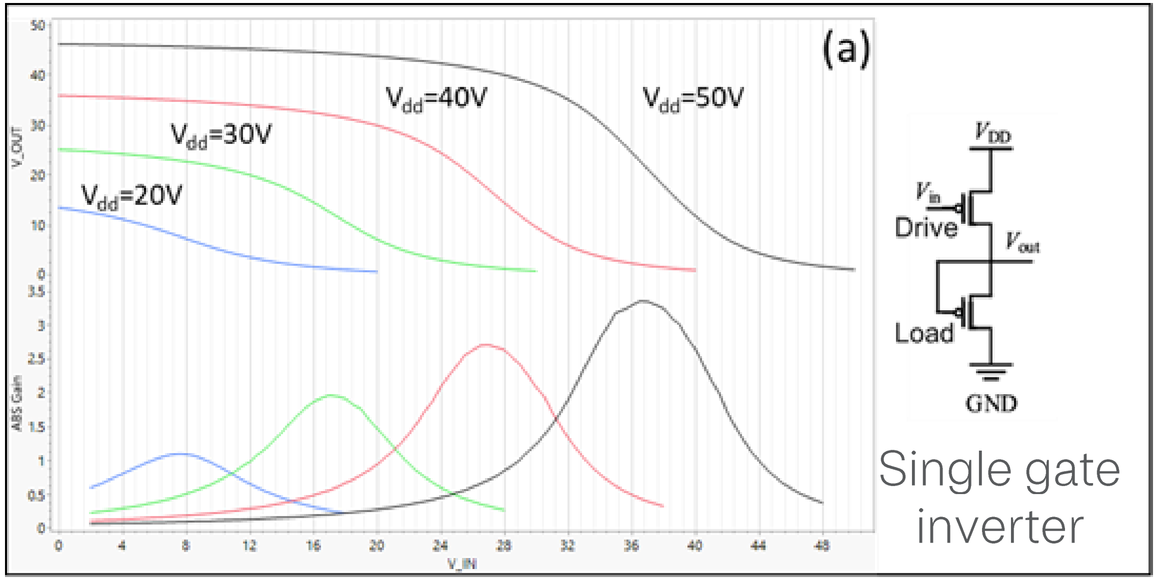
Eliminating leakage current in thin-film transistor of solution-processed organic material stack for large-scale low-power integration

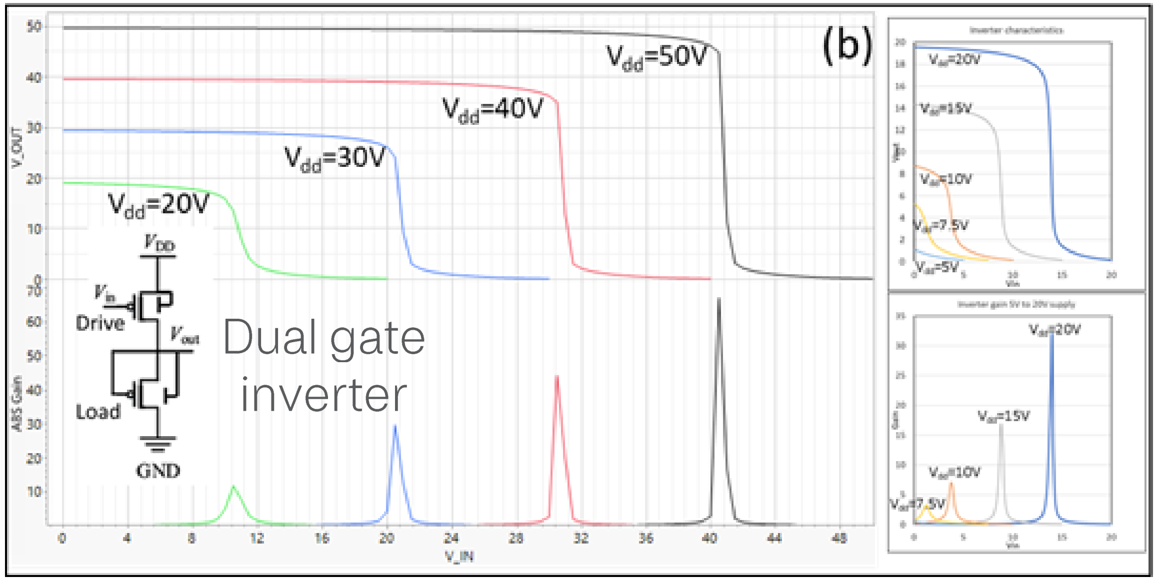
*Lei Han, Jun Li, Simon Ogier, Zhe Liu, Li'ang Deng, Yu Cao, Tong Shan, Dan Sharkey, Linrun Feng, Aiying Guo, Xifeng Li, Jianhua Zhang and Xiaojun Guo**

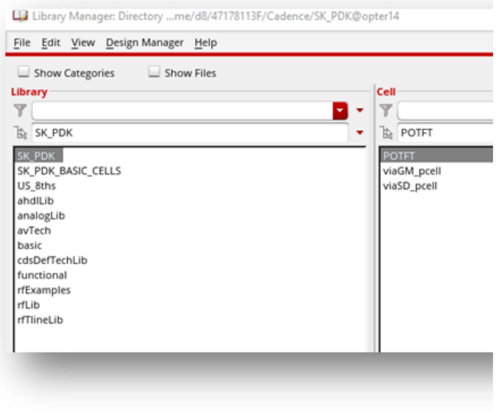


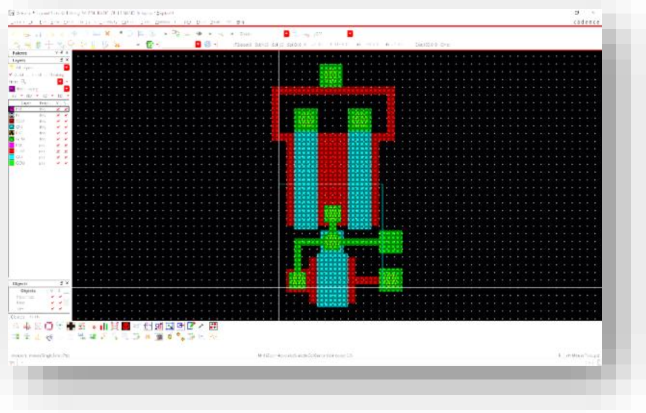
OTFT LOGIC DEVICES AND EDA TOOLS

- PDK developed for OTFT (using Cadence EDA)
- Dual gate logic devices show improved noise margin, lower operating voltage and lower static power consumption vs single gate devices
- OTFT could be used for display gate-on-array and other related driver circuitry (excluding source driver). This saves the cost for additional processing of ICs and also enables greater display flexibility
- Low operating voltage (7.5V) with further reductions expected through dielectric engineering

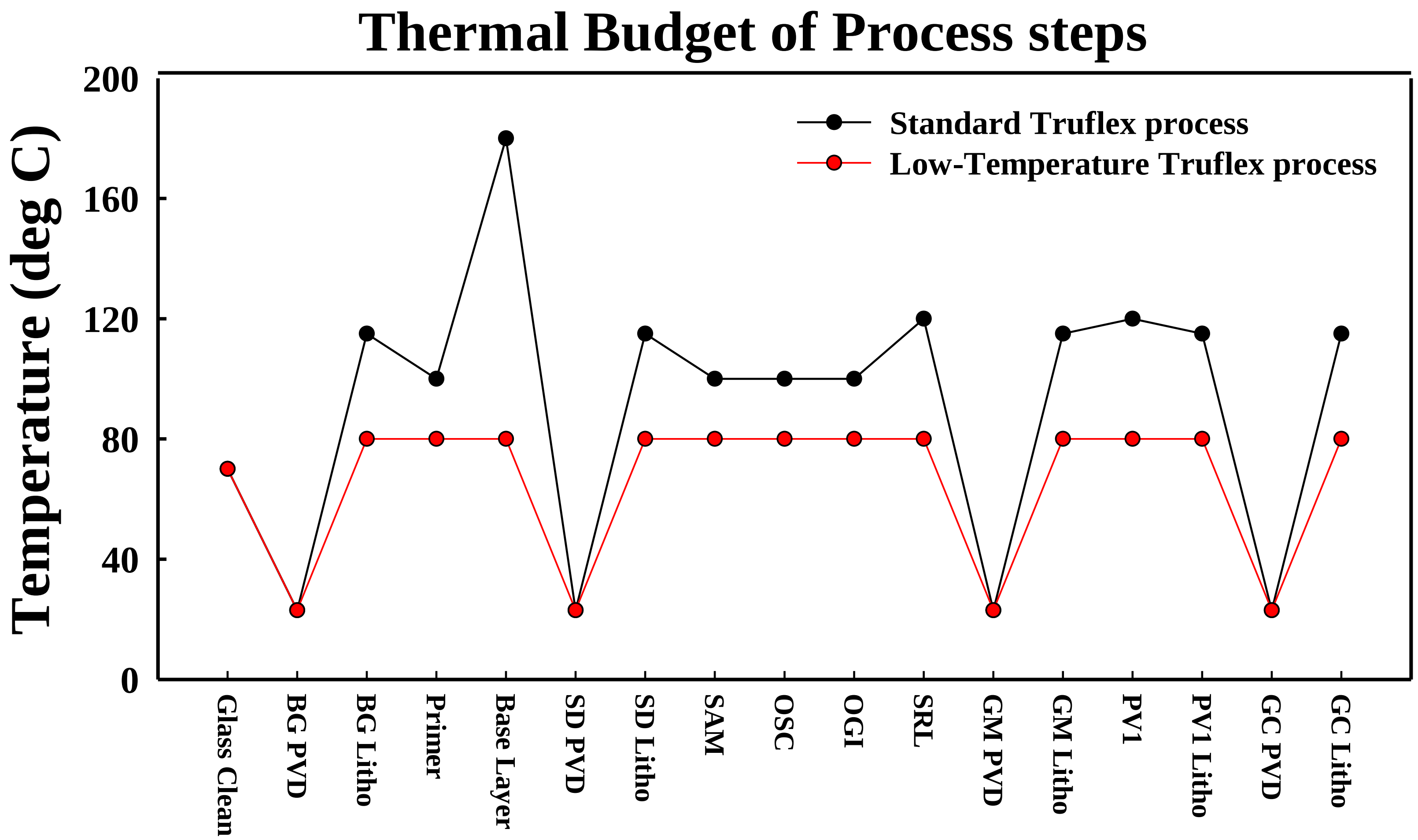






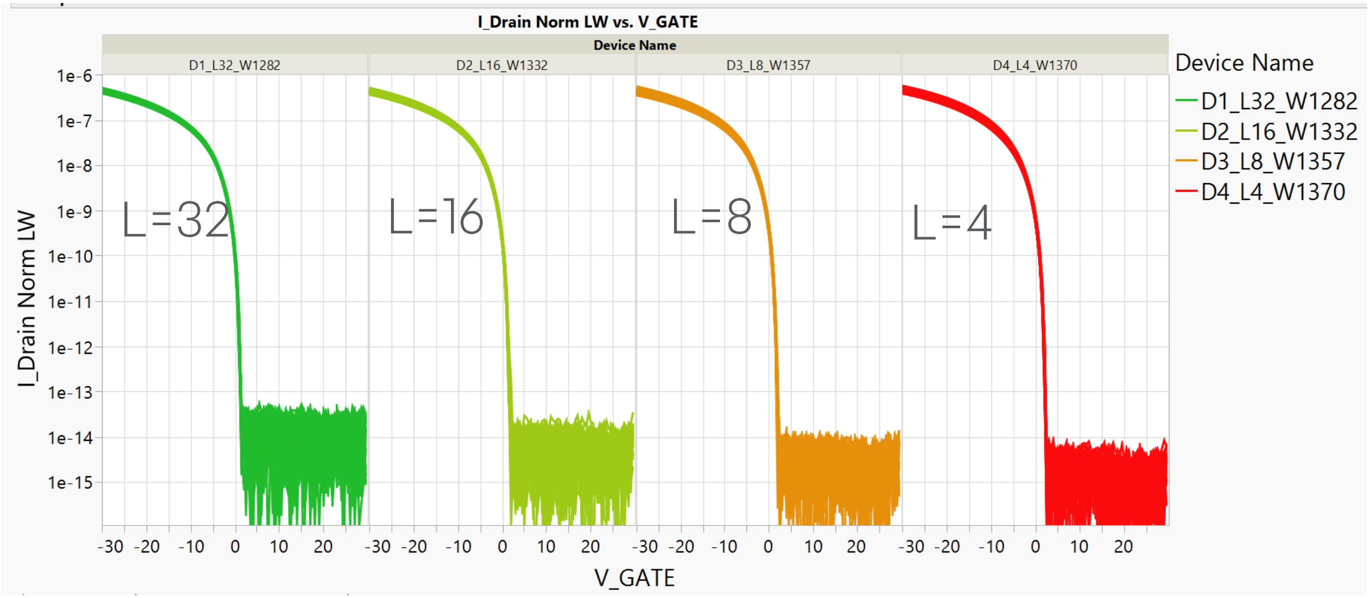


LOWERING THE PROCESS TEMPERATURE 180 ° C TO 80 ° C

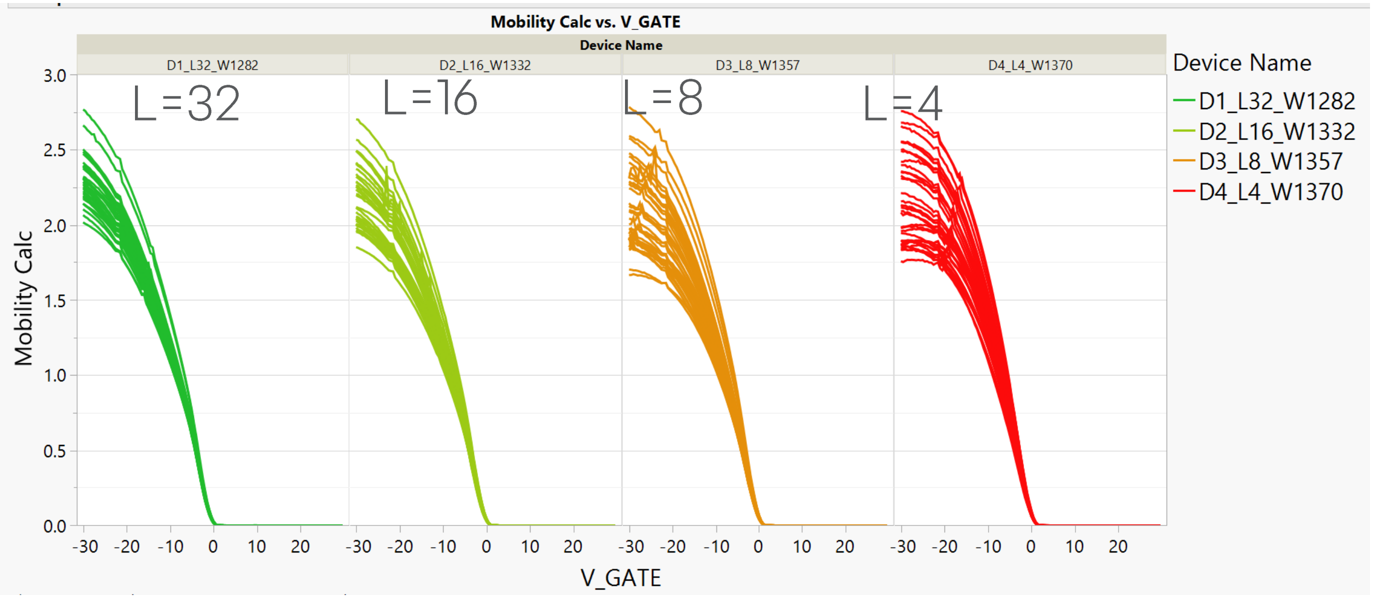


- Single higher temperature step for crosslinking of base-layer re-designed for 80C process
- OSC/SAM/OGI processes changed without any measured impact
- Litho processes lowered in temperature with acceptable changes in dimension of processed features

TFT PERFORMANCE AT 80˚C



- Normalised IV curves for Corbino devices look similar at all channel lengths



- Mobility >2cm^2/Vs for all channel lengths
- Width normalised contact resistance typically less than 200 Ohm.cm

PROTOTYPING AND MANUFACTURING READINESS

- Scaled up to G2 glass and flex
- Slit/Slot die coating formulations available
- Rapid prototyping of designs using direct write lithography now available for demonstrator generation
- Engaging with a partner in the far east to qualify the worlds first OTFT roll to roll process.

Direct write lithography

4”, 8”, 12”, G2 (370mmx470mm) available

RiTdisplay JDA

In October 2021, SmartKem announced a joint development agreement with RiTdisplay to collaborate on the production of a full color demonstration AMOLED display.

RiTdisplay are the #1 producer of PMOLED displays (small sized).

PMOLED is limited to small resolution (max 200 lines), small size, low luminance (<50% of normal AMOLED).

RiTdisplay project with SmartKem is to develop active matrix OTFT driven OLED displays.

Project targeted at full colour AMOLED on Gen 2 line.

Integrating shift register and mux de-mux functionality into the backplane

AMOLED colour

PMOLED 2 colour

PMOLED monochrome

PMOLED monochrome

Nanosys JDA

SmartKem and Nanosys announced on February 2nd a joint development agreement to collaborate on a new generation of low-cost solution printed MicroLED and quantum dot materials for advanced display.

Both companies believe a “fully solution-printed display” using SmartKem Organic TFT (OTFT) and Nanosys’s microLED and quantum dot nanoLED technologies should result in the creation of a new class of low power, robust, flexible, lightweight displays.

UCSB Membership

In December 2021, SmartKem announced that it became a member of the University of California, Santa Barbara (UCSB) Solid State Lighting & Energy Electronics Center (SSLEEC) which is conducting innovative research into the development of microLED displays.

SmartKem will have the right to obtain access to technologies and intellectual property developed by the Center.

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It is an observation and projection of an historical trend. Rather than a law of physics, it is an empirical relationship linked to gains from experience in production.

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THANK YOU

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