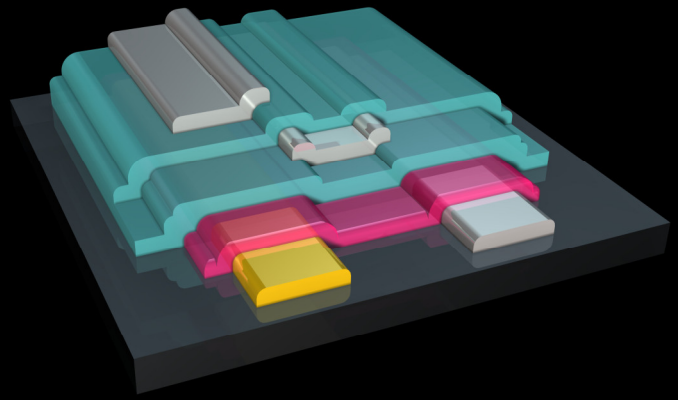
The Multimodal Transistor – MMT –



A paradigm shift in TFT design: simple, fast, robust implementations with reduced footprint and cost for (IoT) mass markets

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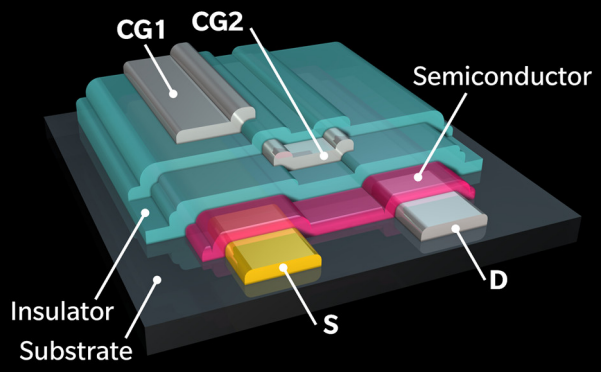
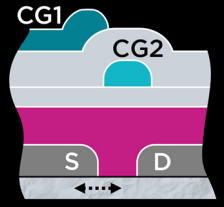
Structure and fabrication

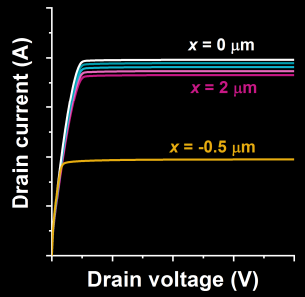


- Technology-independent implementation
- Staggered-electrode configuration
- Bottom or top gate architecture
- Energy barrier deliberately engineered into the source contact
- Multiple-gate design for versatile mixed-signal operation in large area electronics beyond display

Robust operation

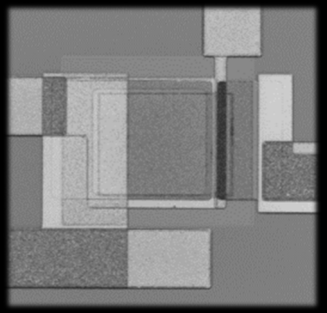
Tolerance to geometrical registration and material property degradation over a wide range for facile implementation with low-cost technologies, alongside conventional TFTs.





Project Status

- Transistor demonstration in microcrystalline silicon (bottom gate configuration)
- TCAD devices and circuits
- Organic and oxide device fabrication ongoing (top gate configuration)
- Research funding application pending decision



Publications

PCT/GB2019/053383

Display Week 2020: 31.1, P.18

Journal paper submitted

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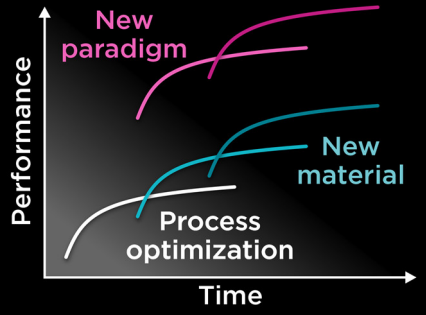
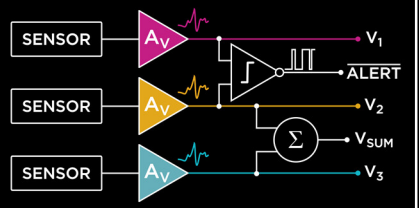
Features and benefits

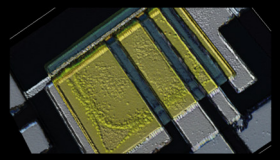


A new TFT design paradigm, scalable with material and process optimisations

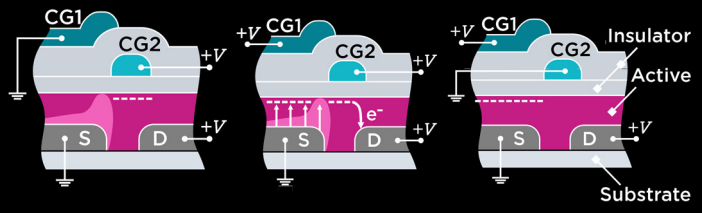
Compact layout for multiple analog and mixed-signal blocks for highly functional circuits at reduced footprint, energy and cost



Robust, material-independent design rules for facile integration with existing processes



Independent control of charge injection and transport

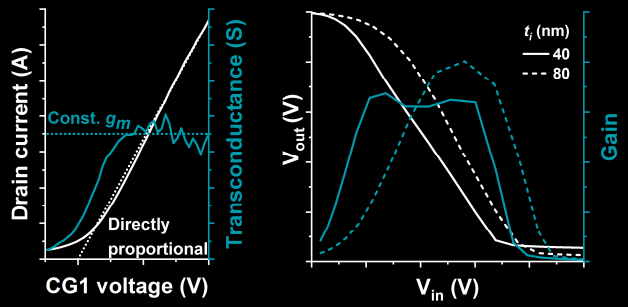


CG1 controls magnitude of the current
CG2 controls the on/off device conductivity
Current is independent of drain voltage

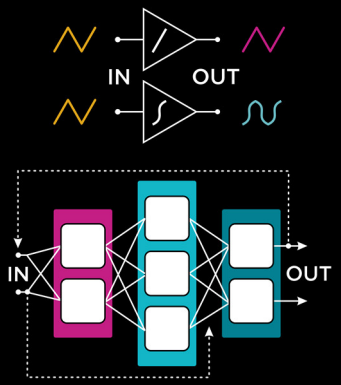
Input-output linearity

Output current can be designed to vary linearly with input voltage in saturation.

The constant transconductance enables low-distortion analog operations e.g. amplification, simplifying circuit design

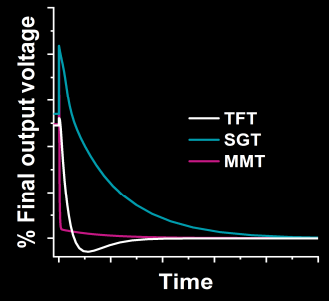


Compact, robust linear circuits with high gain pave the way for low-cost neuromorphic circuits in thin-film technologies



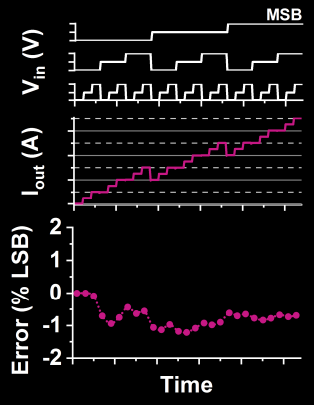
High-speed operation

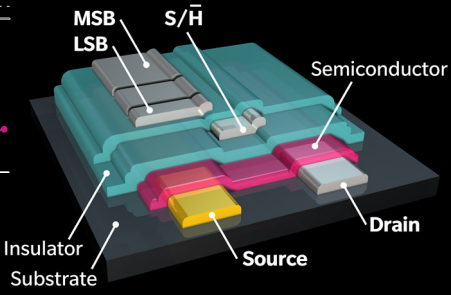
Contact-controlled transistors usually have low cut-off frequencies. MMTs pre-charge source capacitance, redefining the possibilities in fast, efficient and high noise margin circuits



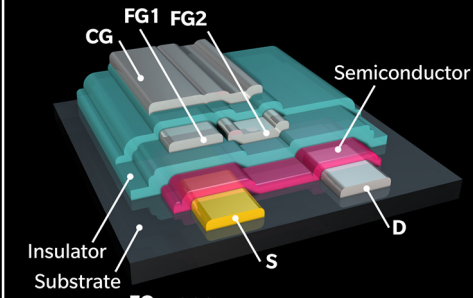
Analog and digital control

Multilevel logic digital-to-analog conversion and multiplication in a compact layout minimises error due to device linearity.

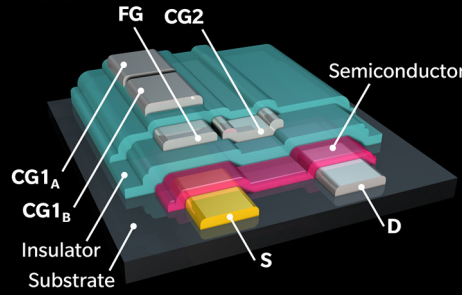




Floating gate designs



Solving parasitic coupling limitations of analog floating gate circuits identified but not answered since 1967.



Versatile analog operations e.g. summing with multiple CG1 inputs

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