



Northern Way OTFT backplanes for e-paper

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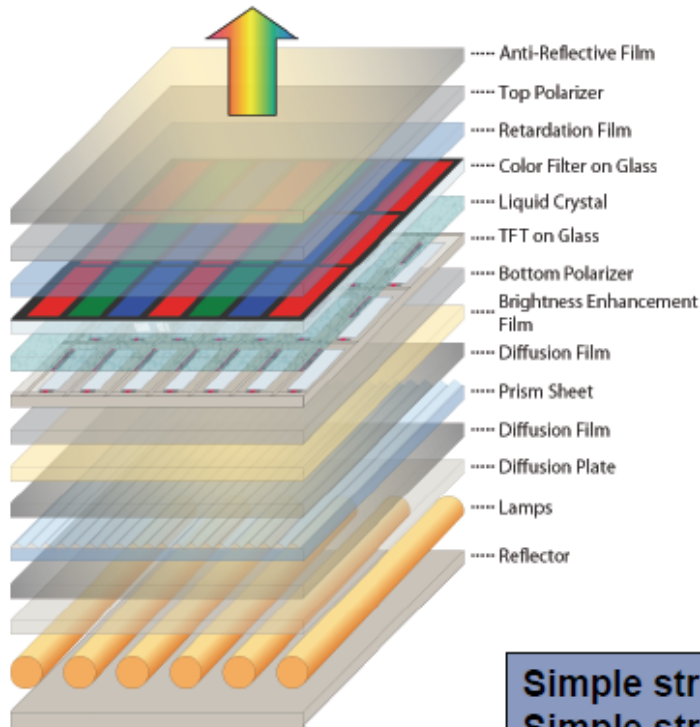
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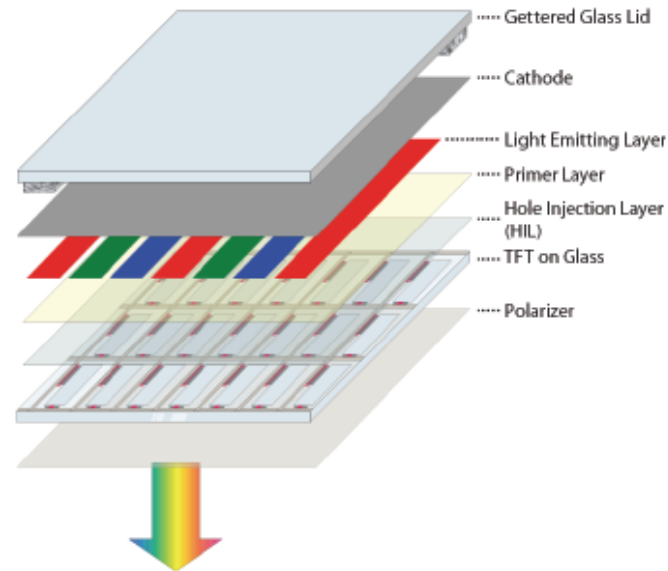


Active matrix backplanes for high performance displays

AM-LCD Structure



AM-OLED Structure



Simple structure gives superior performance.
Simple structure should lead to lower cost.

AM-LCD industry
~\$100Bn p.a. market

Organic-LED technology is here now,
\$2Bn market and growing fast

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Organic thin film transistor (OTFT) backplane technology can help realise flexible, lightweight, robust displays of the future



Plastic Logic



Polymer Vision
The rollable display company



Foldable OTFT-EPD



Samsung ID card
OLED display



Sony – rollable OTFT-OLED



Samsung “unbreakable”
flexible OLED display

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Workpackages 4 & 5 – integration of Organic Semiconductor Materials into Display backplanes



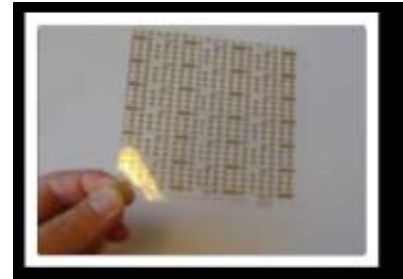
UK University and Chemical Companies
Develop and Scale up OSC
actives (Nway WP 1 & 2)



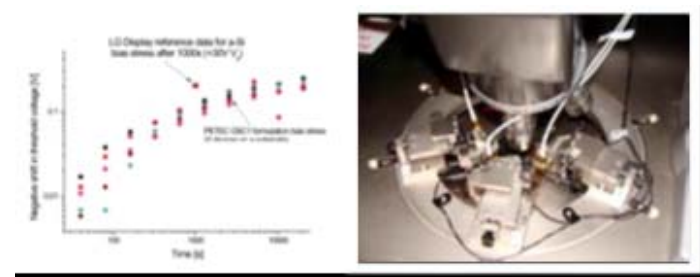
Develop backplane processes for displays WPs 4 & 5



Formulate Ink & develop
Process



Fabricate Initial 4x4 inch
array of transistors



Extensive device testing

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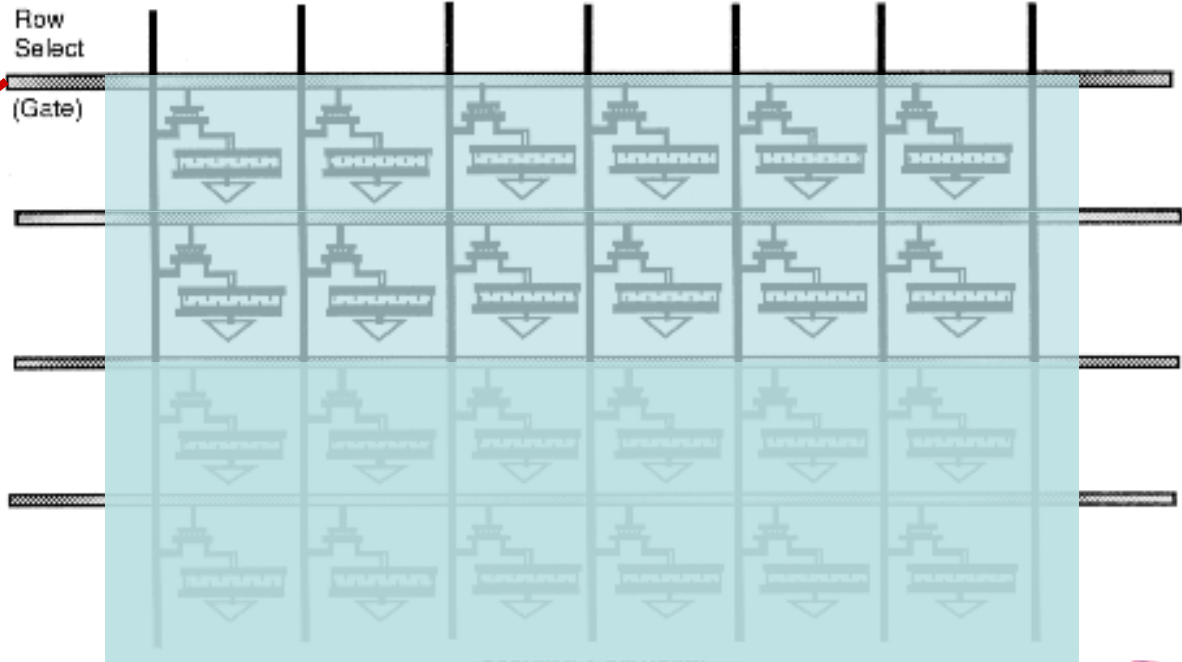


Display backplane operation

- The control process:

Data Lines control this row pixels independently

Column Select (Data, Source)



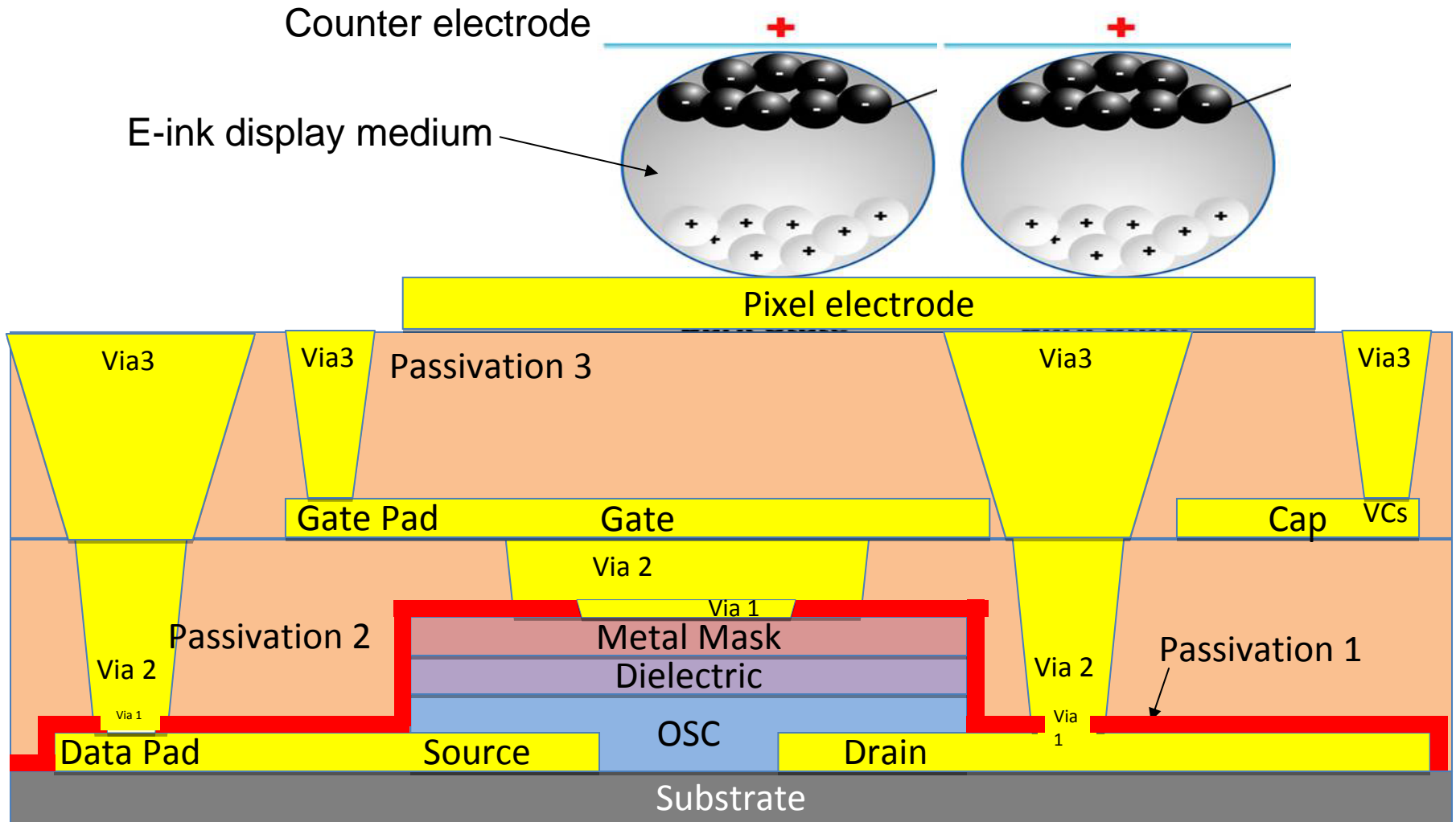
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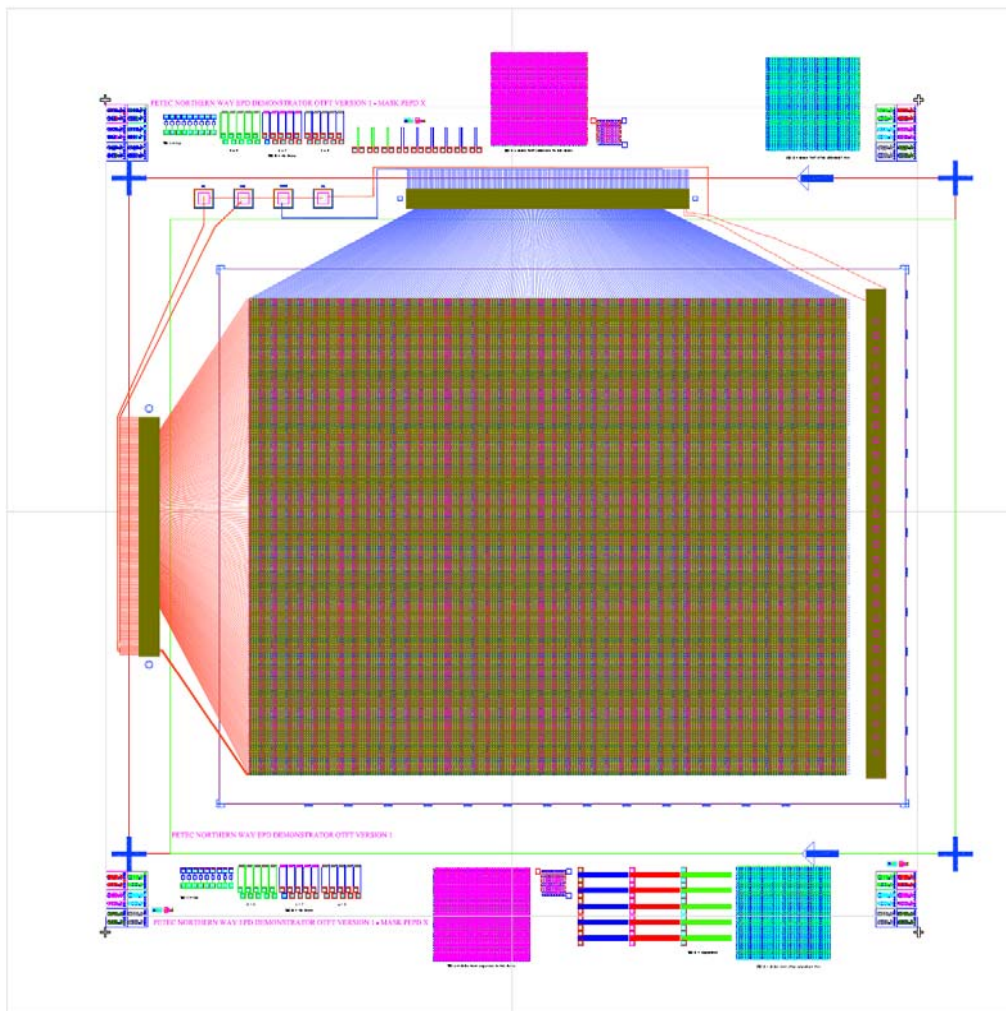


Workpackage 5 - Electronic Paper device cross section



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Completed Mask Design (4" square substrate)



- 7 layers, 48,000 pixels, fan out to 200 x 240 pads
- Test Element Groups (TEGs) for:
 - OTFT (after stages 2,5,7) and in groups of 100
 - Via chains
 - Serpentine
 - Capacitors
- ~100 process steps - takes ~2 days beginning to end

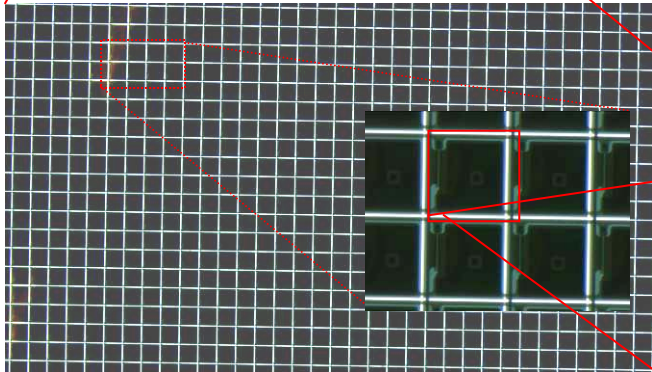
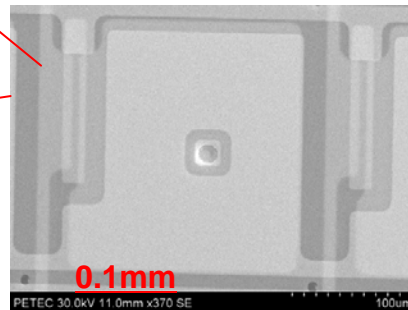
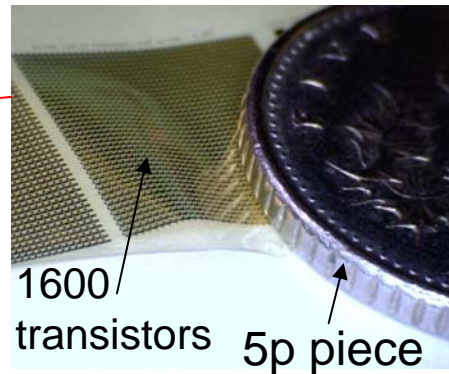
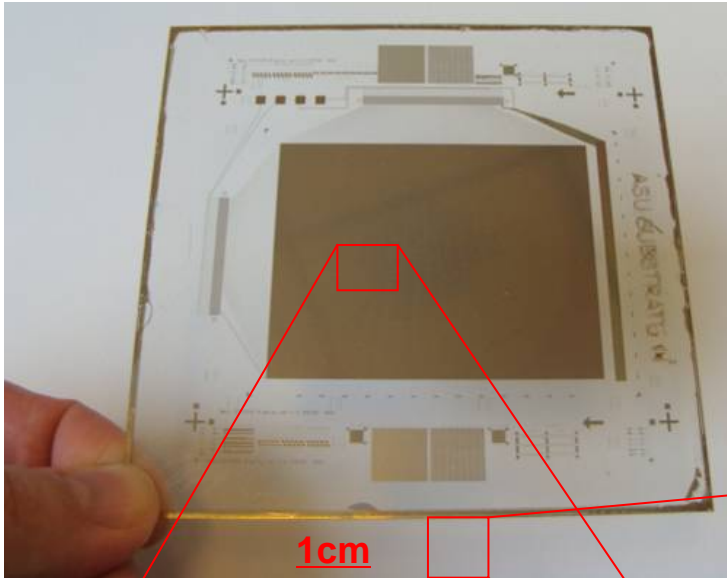
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Current OTFT backplane design in PETEC

- 106ppi e-paper backplane
- 6 micron minimum feature, 5 micron design rule (overlay accuracy)
- 3" diagonal, 48,000 transistors



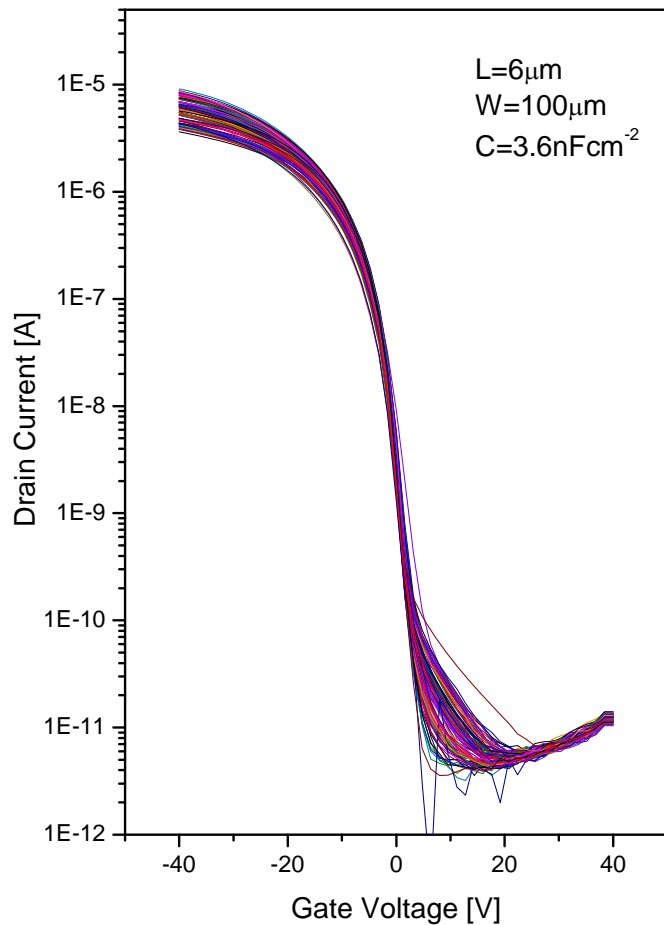
1mm

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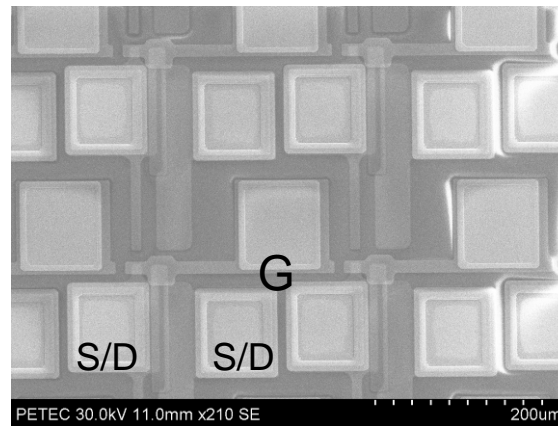
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TEG (Test Element Group) device testing



- Mobility for devices $\sim 0.7 \text{ cm}^2/\text{Vs}$
- Example shown is on PEN plastic substrate
- On/off ratio $> 5 \times 10^5$
- TIPS Pentacene based formulation

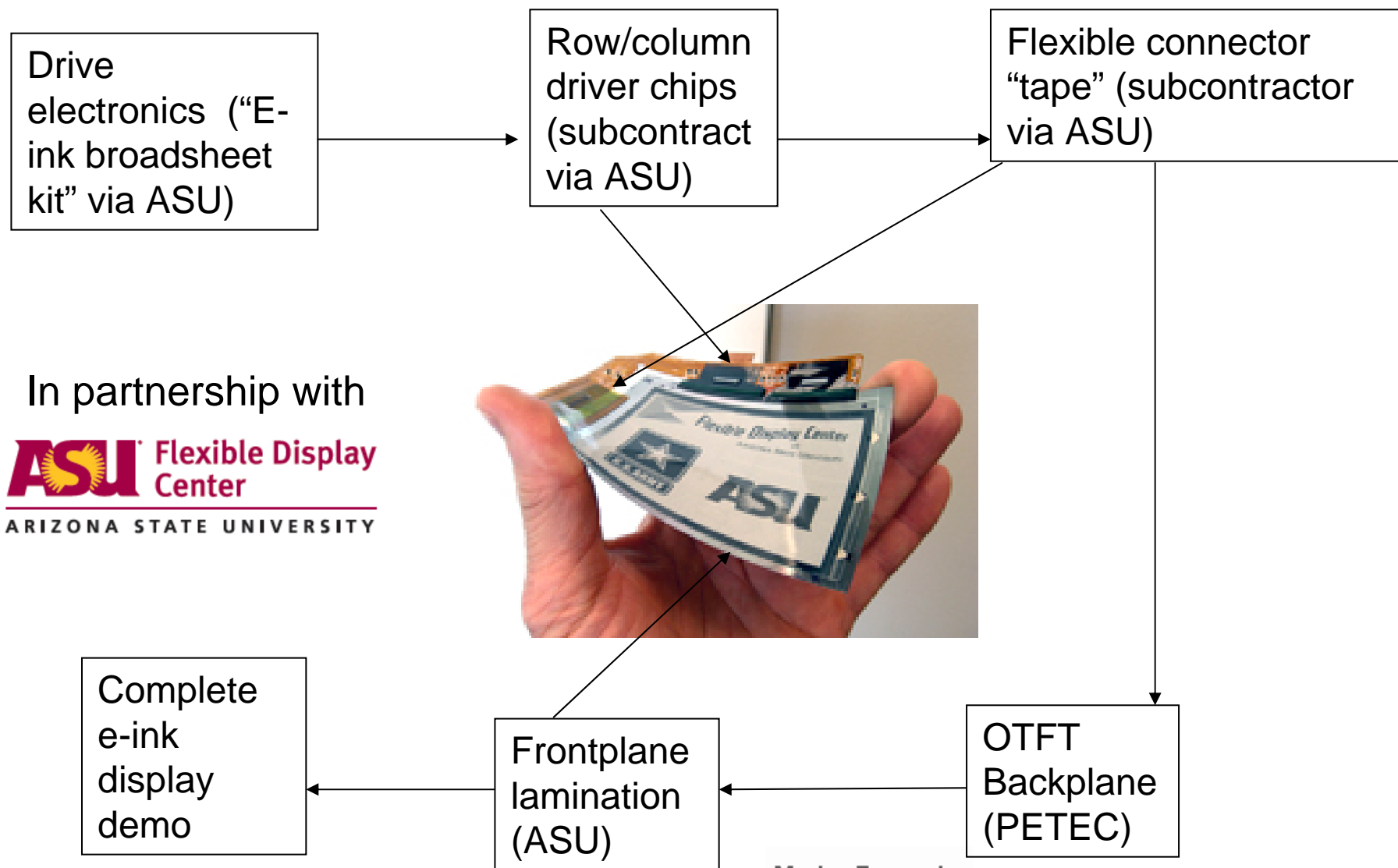


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Integration with e-ink frontplane



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Backplane processing

- Backplane design validated at ASU to produce working display examples
- Contact lithography process adds 50 sizeable (few μm) defects per mask contact
- PETEC phase 2 facility will have UV stepper system, so yield should increase significantly later on this year

106 ppi, 3" diagonal



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Summary

- Developed OTFT backplane process for e-paper
- Transistor performance high enough to drive LCD
- Other materials developed from Northern Way chemical companies could drive OLED displays
- Work ongoing to improve display quality and expand applications to OLED on flex

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