

# roll-out

Roll-Out final review  
Highlight results

Conclusions on future research needs

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# Highlight results



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- Three demonstrators: smart bottle, car window control and car seat sensor array that were presented in Semicon 2017.
- Lab-scale sputtered ZTO TFTs operate at very low voltage (peak  $\mu_{FE}$  obtained for  $V_{GS}=5$  V, where On/Off ratio already exceeds  $10^6$ ) owing to the integration of a high- $\kappa$  multilayer dielectric based on  $Ta_2O_5$ - $SiO_2$ . These properties are not affected by bending for 15 mm radius.
- Implementation of complete readout circuitry for fill-level and temperature monitoring, entirely based in oxide TFTs. All blocks are verified to be functional but improved processing yield and uniformity in 4" area are required to demonstrate full system functionality.
- Completion of three fully roll-to-roll process runs for thin film transistors and circuits combining printing, evaporation, lift-off, sputtering and ALD fabrication steps at three different partners. Usage of silver nanoparticle ink for S/D contacts of oxide TFT has been developed based on interface modification with PEI as presented in 2017 MRS Fall meeting.
- Ink-jet printed ITO interlayer for contact band engineering was presented at ITC 2015 and Published in Journal of Display Technology in 2016
- A printable all-organic proton battery has been presented. The battery is completely devoid from metals and can, in principle, be disposed of by combustion.

# Conclusions on future research needs



- Demonstrating R2R ALD for global markets.
- Develop the TFT sputtering process for improved process yield and uniformity, reduced parasitics and minimized channel length.
- Integration of oxide TFT technology with stretchable electrodes and substrates.
- Reliability and quality control of the R2R processes.
- High-resolution printing to limit overlap capacitances and reduce channel length.
- Development of battery material combinations with improved voltage output.
- Inks that can be elastic and washable and at the same time withstand a high degree of abrasion.
- Testing procedures and methodologies for fast online inspection
- System-level development of sensor applications in thin-film and conventional electronics: integration technologies (ACF, SMD on flex/print),  $\mu$ C electronics, (few-devices) thin-film building blocks.
- R2R sputtering for dielectric materials
- Smart bottle interface to mobile phone and data logging to track product condition and consumption to increase customer interest.
- Increase the level of integration of electronics into sensor films.