



SILVACO

Victory RCx Pro Competitive Analysis

Technology-Driven Parasitic Extraction Tool

Victory RCx Pro Competitors

- Raphael (Synopsys)
- QuickCap (Magma)
- Q3D (Ansoft)
- Cell-AN (OEA International Inc)

Victory RCx Pro Competitors (con't)

- Victory RCx Pro Advantages over competitors:
 - Best accuracy with user selected tolerance and adaptive local mesh refinement
 - Built-in realistic 3D etch and deposit process
 - Built-in physics based lithography simulator
 - Built-in netlist extractor
 - Automated contact and gate electrode SPICE netlist annotator
 - User selectable materials and boundary conditions
 - Best for Deep submicron CMOS, Flat Panel LCD and TFT, Memory Manufacturing and MEMS simulation

Applications

- Victory RCx Pro fits well as an RC extraction tool in the following markets
 - Deep submicron CMOS
 - Realistic 3D back end process simulations and accurate interconnect simulation with user-selected tolerance
 - Accurate via detailed capacitance and process analysis of individual problematic features, such as 45 nm via structures
(via capacitance is now a significant source of capacitive delay)
- Victory RCx Pro fits well as an RC extraction tool in the following markets
 - Flat Panel LCD and TFT circuits
 - Special features to deal with high aspect ratio structure
 - SED Television technology
 - Memory manufacturing
 - SRAM and Flash Memory cell
 - MEMS simulation
 - Systems-on-a-chip brings together silicon-based microelectronics with micromachining technology

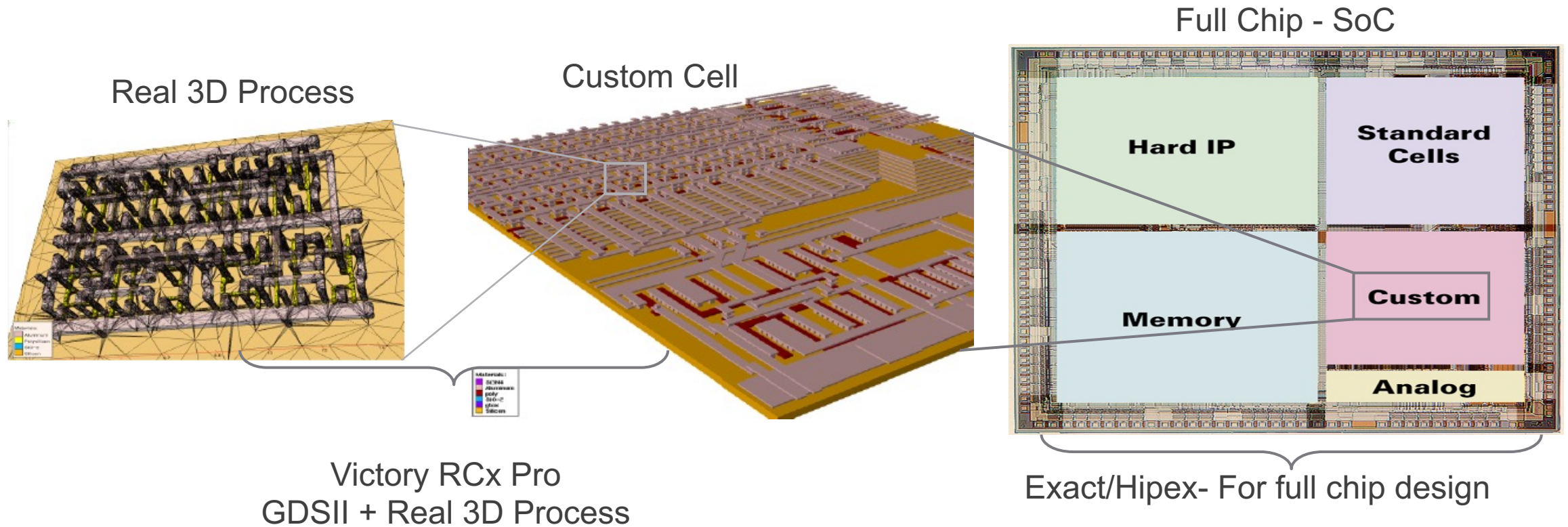
Advantages Against Competing Tools

- No restriction on geometry size – 65nm, 45nm and below
- Realistic Structure Generation – suitable for all technologies and arbitrary 3D shapes
- RC extractor capable of reproducing the lithographic effects of Optical Proximity Correction (OPC) sub wavelength effects, phase-shifts mask (PSM), misalignment, defocus, and CD
- True 3D, mask driven process simulation
- Realistic deposition, etch and lithography
- Netlist extractor to extract active device SPICE netlist
- Automatic back annotation of field solved resistances and capacitances onto extracted active device netlist for immediate SPICE analysis
- Optimize circuit performance as a function of back end process parameters and layout parameters

Advantages Against Competing Tools (cont)

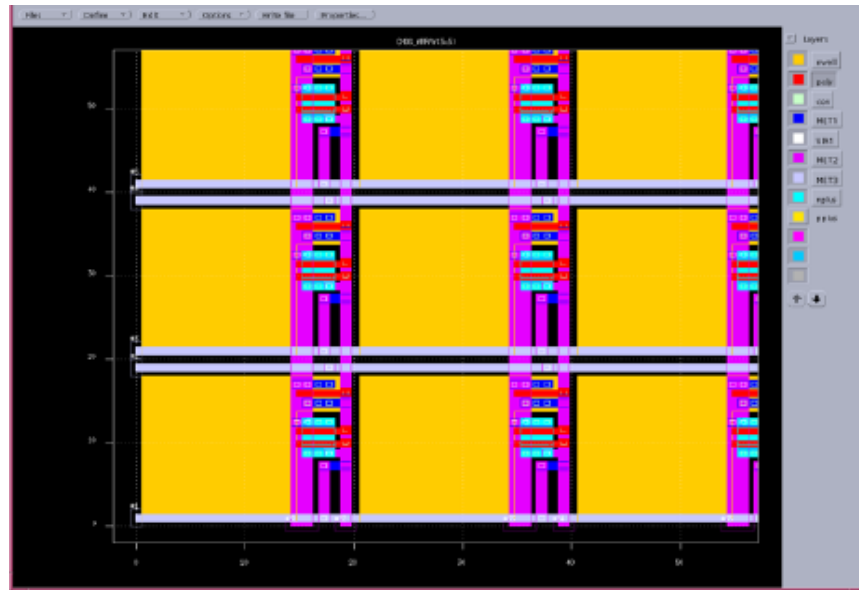
- Full 3D field solver engine directly calculates parasitic RC extraction for best accuracy and handle dummies
- Automatic grid generation and refinement during 3D field solver calculation of capacitance and resistance
- Versatile – small cells using fully realistic 3D processing or larger cells using geometric processing
- User-defined tolerance control on extraction accuracy
- 2D/3D structure Viewer (TonyPlot2D/3D)
- Symmetric boundary condition to allow users to perform Cyclic Simulations
- Selective area parasitic extraction enables maximum accuracy for critical layout windows

Victory RCx Pro – Simulator

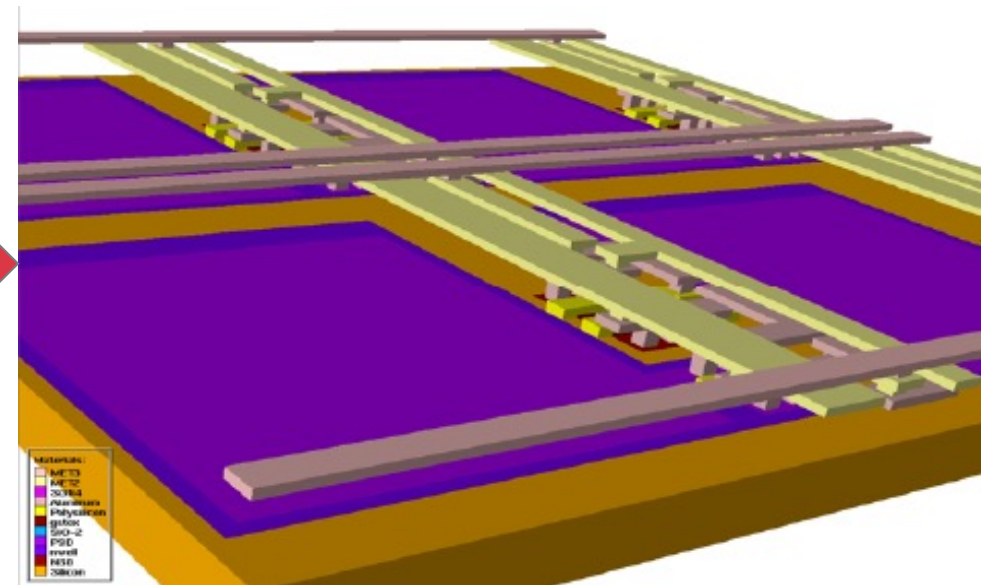


Victory RCx Pro – Layout Driven

- 3D Structures created from Mask Driven Intuitive Process Commands

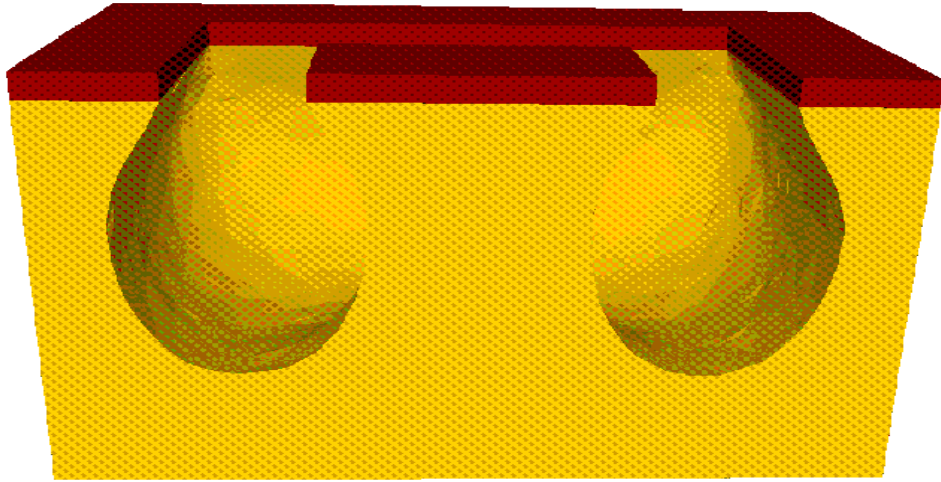


GDS2 Mask Layout

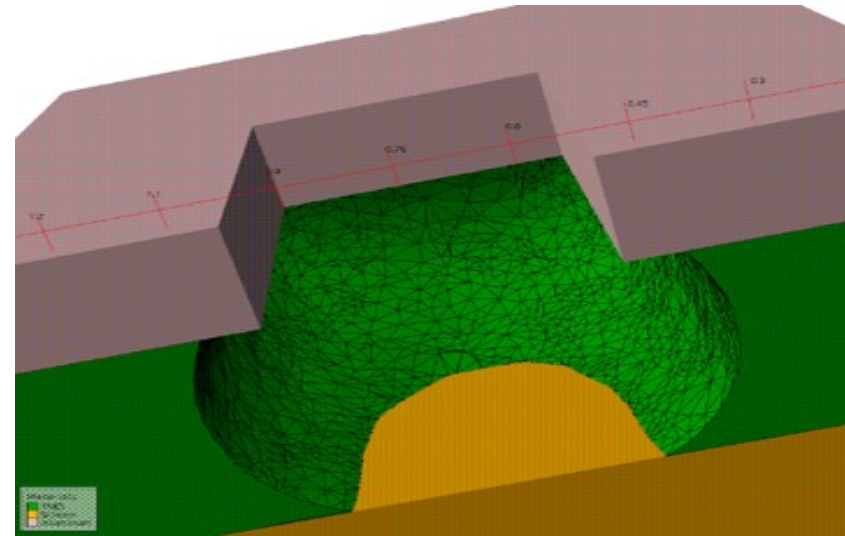


3D Structure

Victory RCx Pro – Tracking Fronts in Etch/Deposition



Directional etching; r_{dir} is determined by the visible “cone” from above.

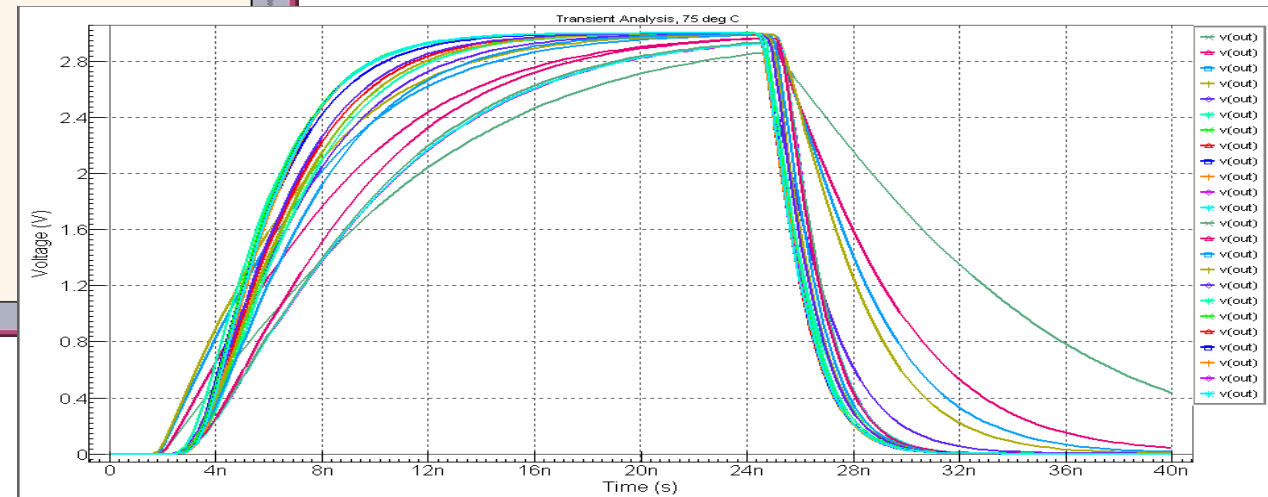


Complex etching capability.

Automated Annotated Spice Netlist Generation

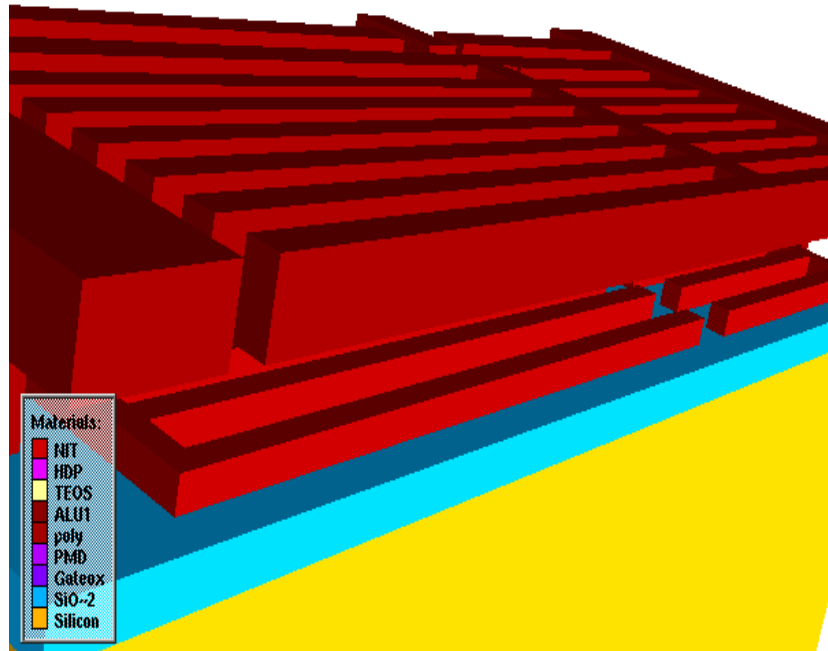
```
Text Editor V3.6.2 FCS - clex17-UV.net, dir: /home/derekk/
File View Edit Find
M1 cont2 gate0 cont1 cont0 myNMOS w=1u l=0.25u As=0.75p Ad=0.8125p Ps=3.5u
Pd=3.5625u Nrs=0.325 Nrd=0.325 geo=1
M2 cont4 gate1 cont3 cont0 myNMOS w=1u l=0.25u As=0.8125p Ad=0.75p Ps=3.5625u
Pd=3.5u Nrs=0.325 Nrd=0.325 geo=2
M3 cont2 gate2 cont5 cont0 myNMOS w=0.6u l=0.25u As=0.45p Ad=0.4875p Ps=2.7u
Pd=2.1375u Nrs=0.5 Nrd=1.95833 geo=1
M4 cont3 gate3 cont6 cont0 myNMOS w=0.6u l=0.25u As=0.45p Ad=0.4875p Ps=2.7u
Pd=2.1375u Nrs=0.5 Nrd=1.95833 geo=1
M5 cont9 gate4 cont8 cont7 myPMOS w=0.6u l=0.25u As=0.45p Ad=0.45p Ps=2.7u
Pd=2.7u Nrs=0.5 Nrd=0.5 geo=0
M6 cont11 gate5 cont10 cont7 myPMOS w=0.6u l=0.25u As=0.45p Ad=0.45p Ps=2.7u
Pd=2.7u Nrs=0.5 Nrd=0.5 geo=0
R1 aux1 aux2 1.160374390207768
R2 aux1 cont10 0.2228859818695045
R3 aux1 cont3 0.1542545991273379
R4 aux2 gate0 0.3981305801896541
R5 aux2 gate4 1.06757931165212
R6 gate3 aux3 0.2672503403293974
R7 gate2 aux3 0.1506987274673539
C1 cont1 cont2 1.395960983877825e-18
C2 cont1 gate0 9.393875983123944e-19
C3 cont1 cont3 9.393875983123944e-19
C4 cont1 gate1 1.395960983877825e-18
C5 cont1 cont5 1.515238318623289e-17
C6 cont1 gate2 1.343839113717431e-18
C7 cont1 bit 1.515238318623289e-17
C8 cont1 wlm 1.343839113717431e-18
C9 cont1 cont6 1.52829157874776e-17
C10 cont1 gate3 1.343839113717431e-18
```

- Immediate Feedback on circuit speed following DOE Process or Layout modifications



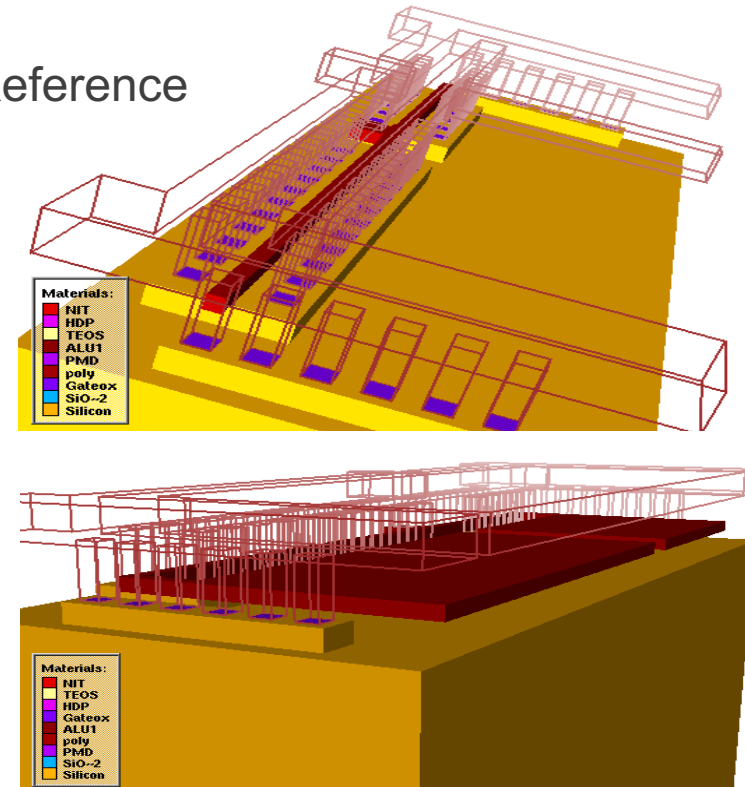
Victory RCx Pro – Deep Submicron CMOS Example

- Three different ring oscillators



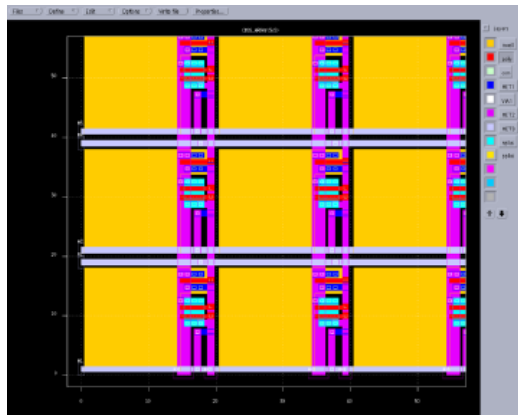
“Fringes” Metal1 over Poly

Reference

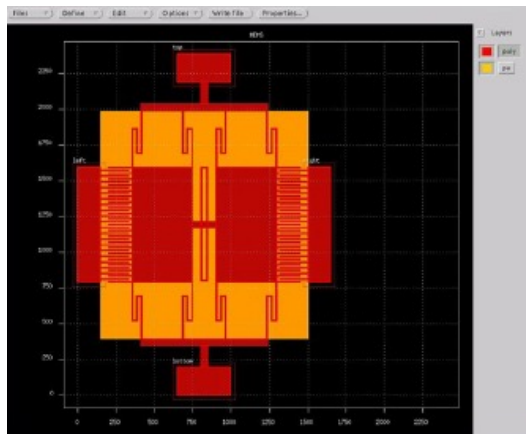
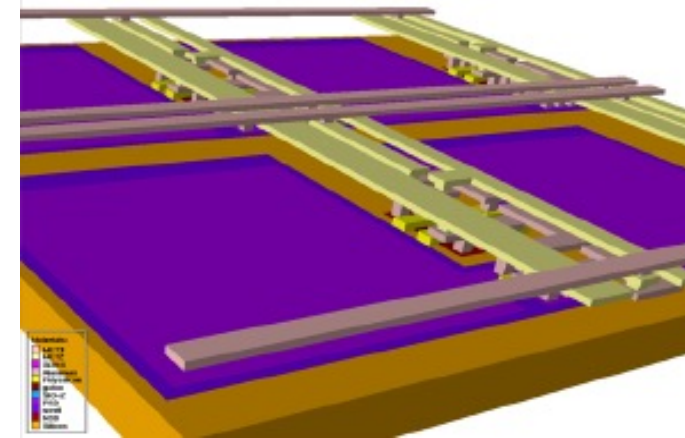


Metal1 plate overlapping Poly plate

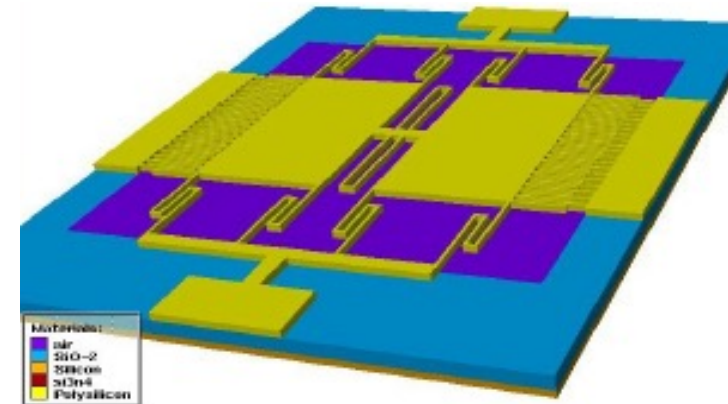
Victory RCx Pro – Deep Submicron CMOS Example



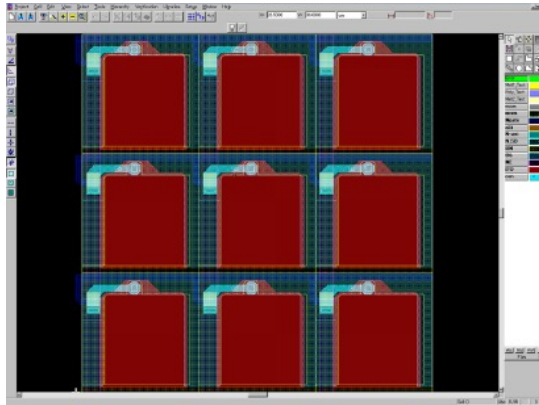
CMOS
Sensor



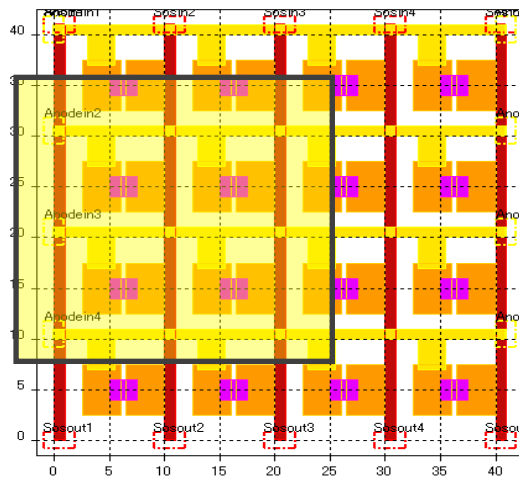
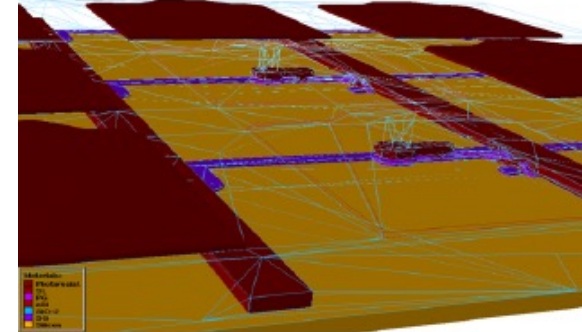
G Sensor



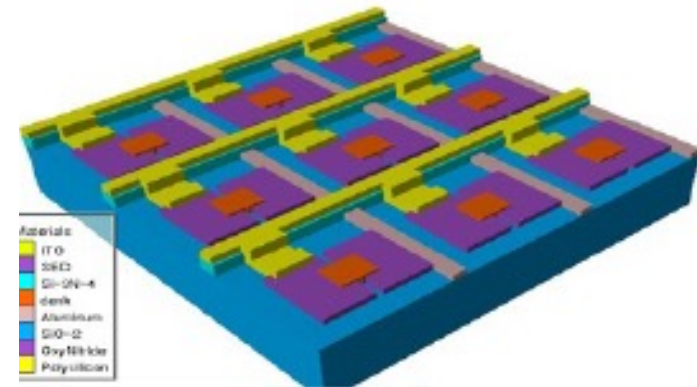
Victory RCx PRo – Flat Panel LCD and TFT Example



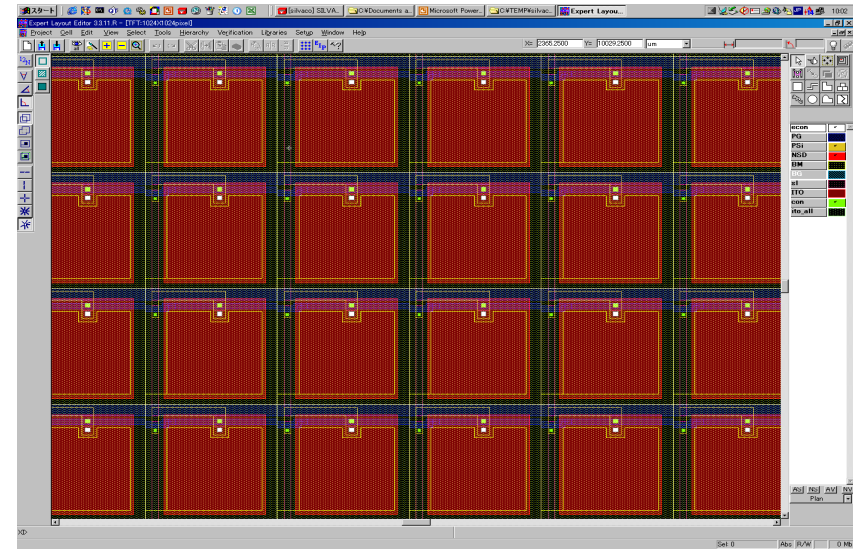
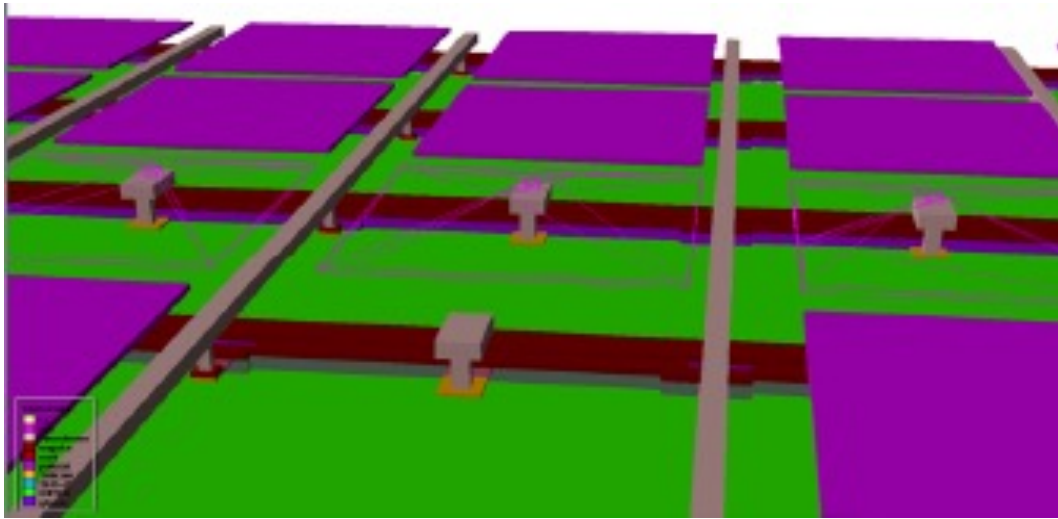
LCD/TFT
Cell



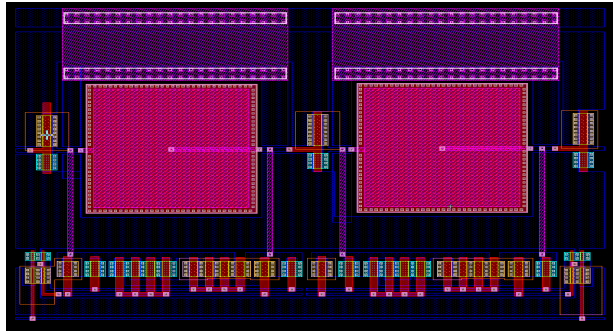
Simulation area
(3x3 matrix)



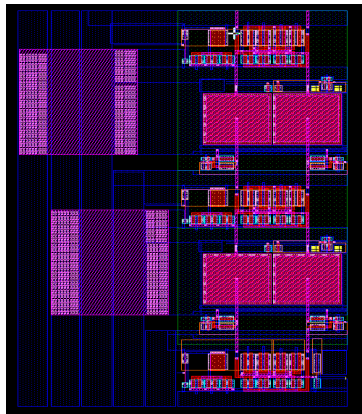
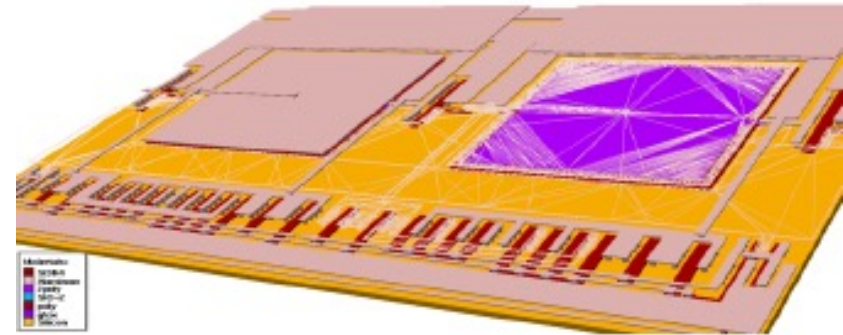
Victory RCx Pro – Flat Panel LCD, TFT Example



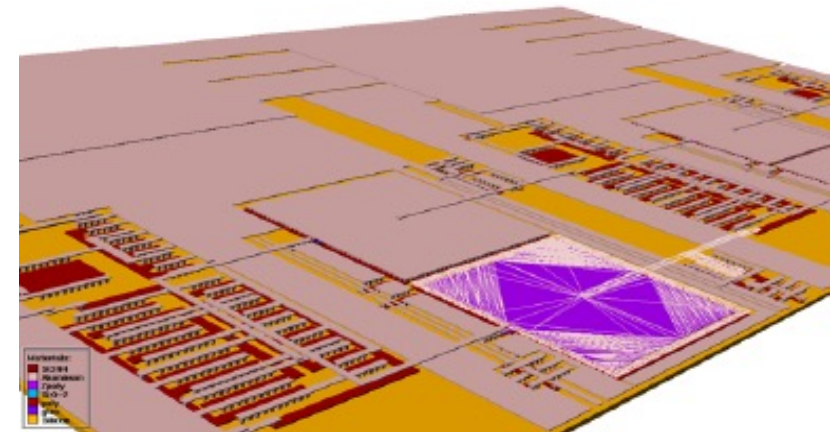
Victory RCx Pro – Comparator Circuit Examples



Comparator 1

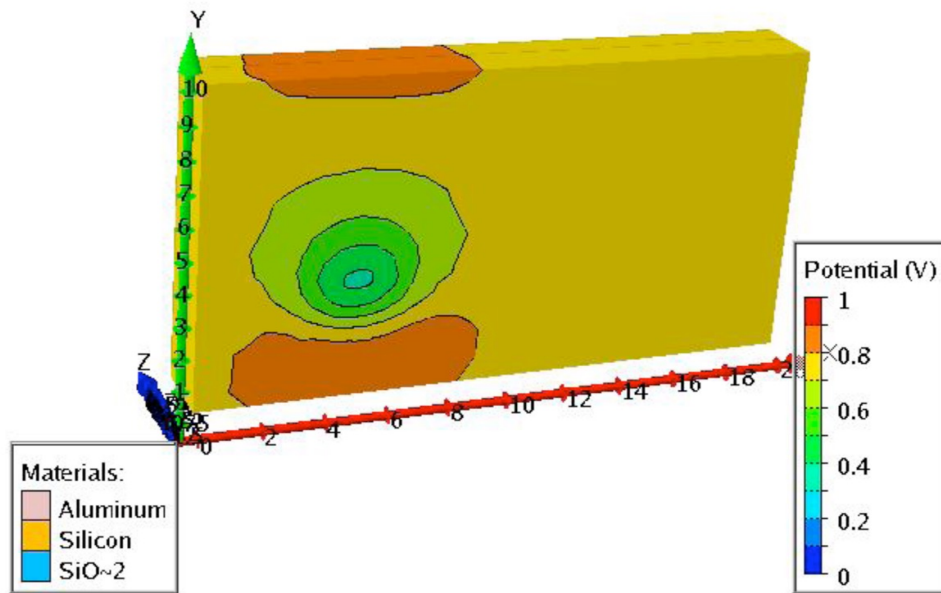


Comparator 2

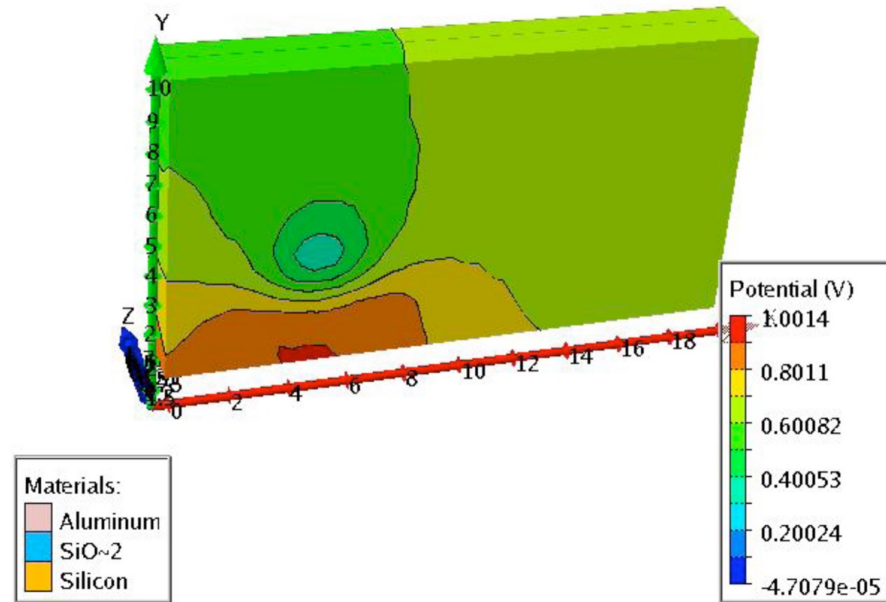


Victory RCx Pro – Unique Functionality

Cyclic Boundary

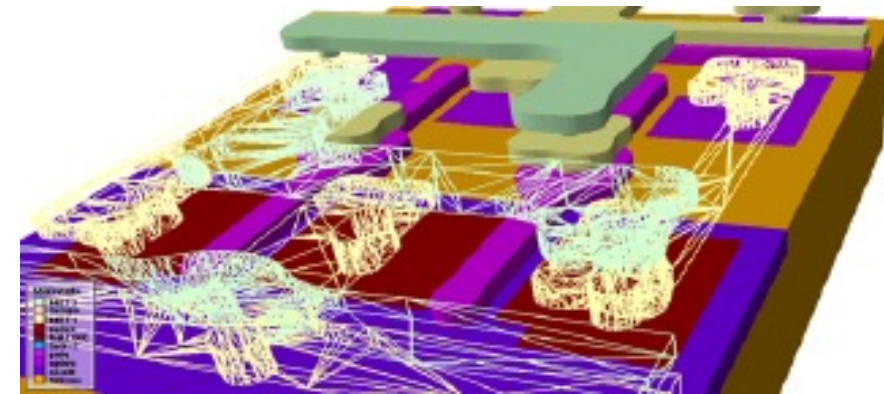
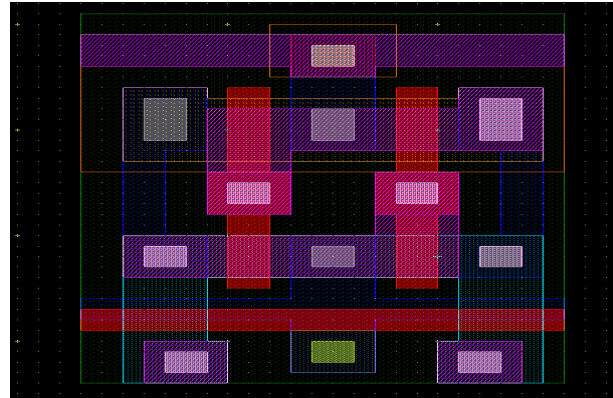


Mirror Boundary

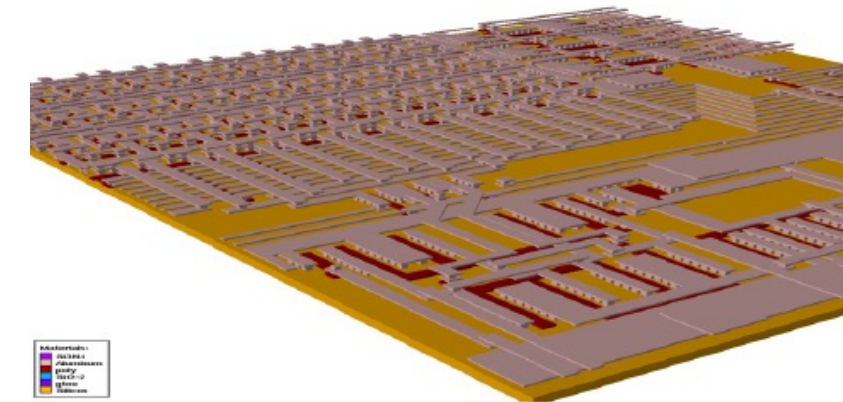
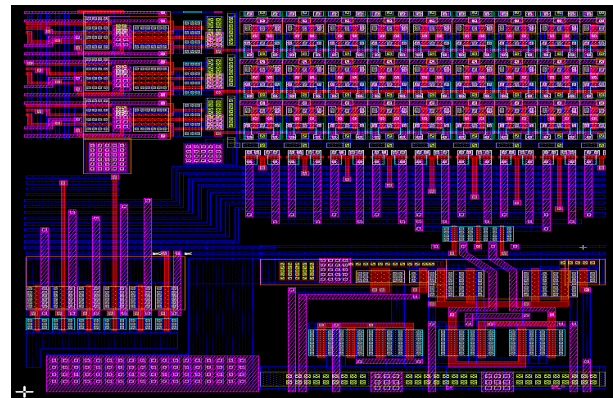


Victory RCx Pro – SRAM Example

SRAM CELL

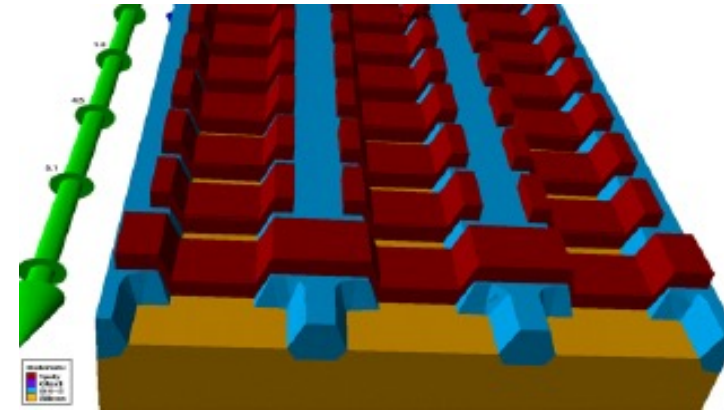


SRAM CELL
and Decoder,
Sense AMP

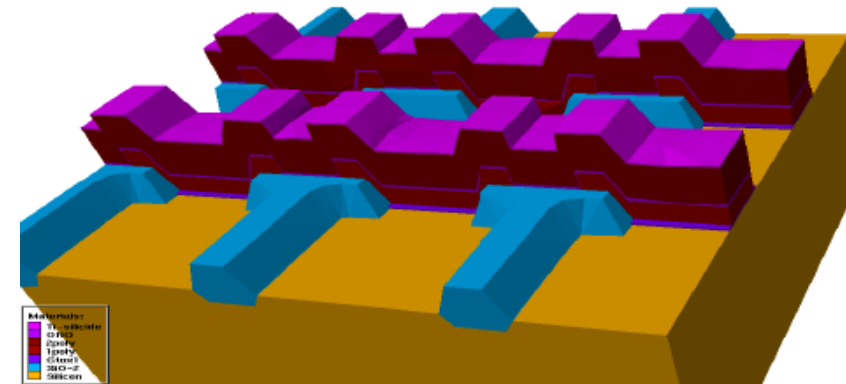
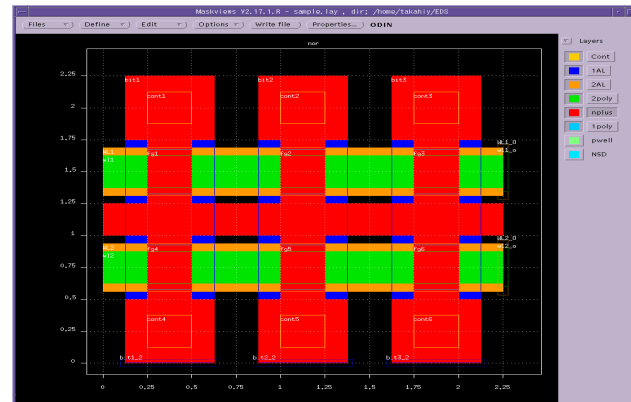


Victory RCx Pro – Flash Memory Example

Flash Memory:
NAND

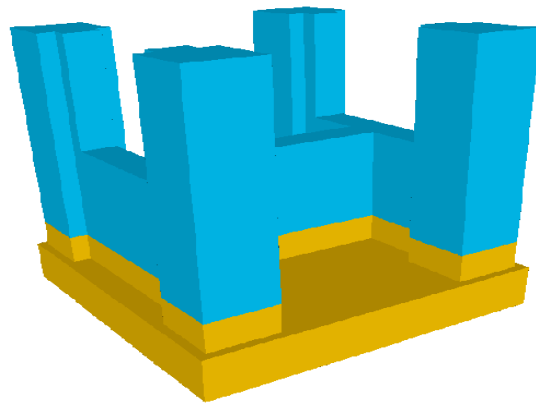
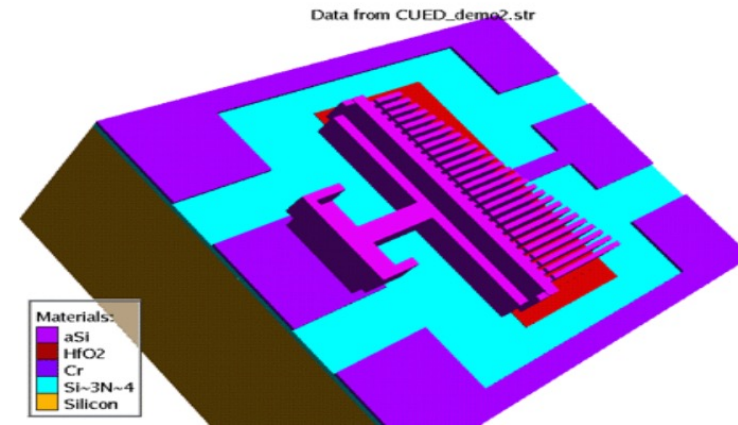
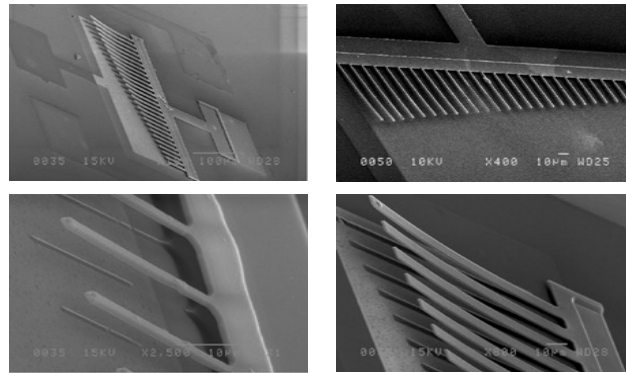


Flash Memory:
NOR

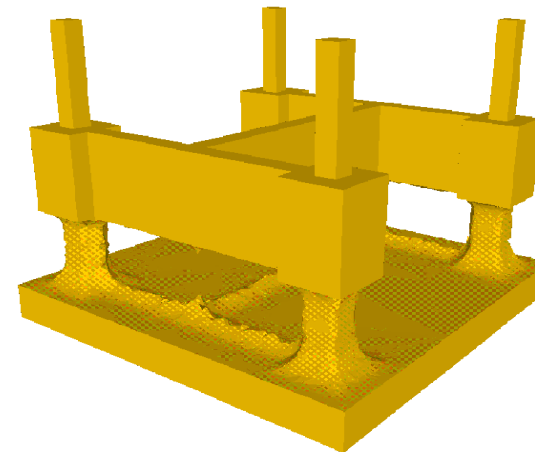


Victory RCx Pro – MEMS Example

Actual MEMS device



Part of a MEMS actuator array



MEMS device after isotropic release etch

Victory RCx Pro – Conclusions

- Victory RCx Pro is your solution for parasitic RC extraction where MAXIMUM ACCURACY is required
- Highly versatile tool – ideal solution for:
- Deep sub-micron CMOS and SOI parasitic extraction for all technology nodes
- TFT pixel arrays where many conformal depositions make capacitance analysis using traditional rule based tools too inaccurate due to multiple topology effects.
- True 3D parasitic interconnect effects are automatically passed to SmartSpice to enable the most accurate circuit simulations