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a-IGZO FORC: Film on Readout Chip Simulation

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The Goal

- Hoping to deposit sensor material directly onto CMOS pixel readout chips
  - Allows for independent optimization of chip and sensor development
- Have no functioning prototype!
- Hope a simulation can better inform our physical results
  - allows us to iterate on new materials computational

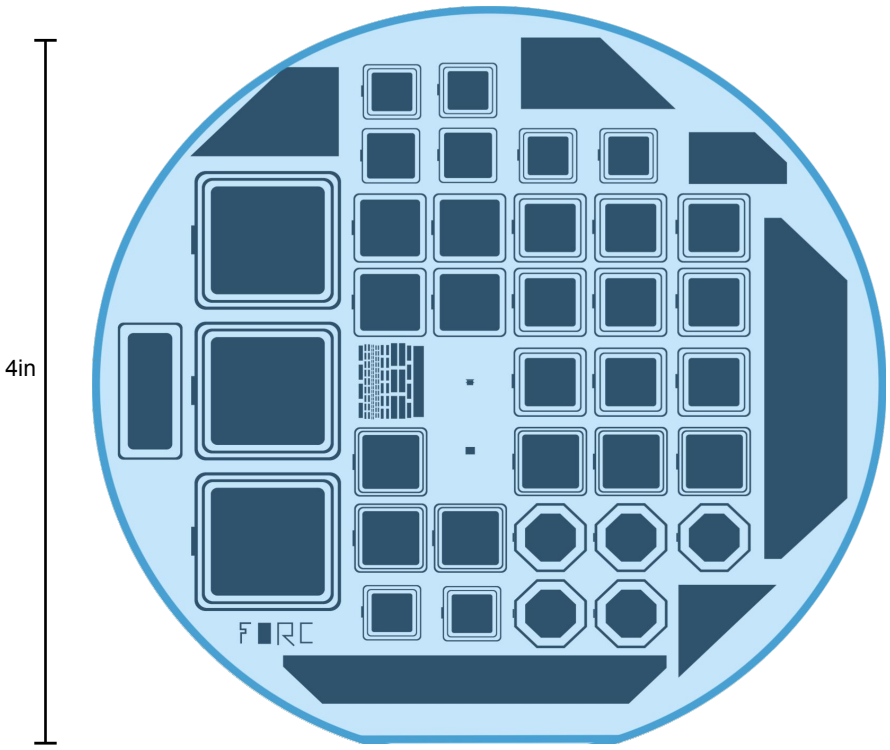
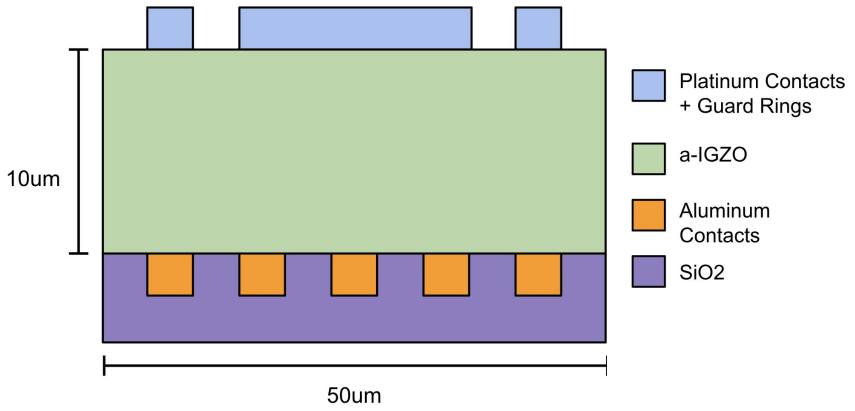


Fig 1: Representation of the current diode mask

a-IGZO

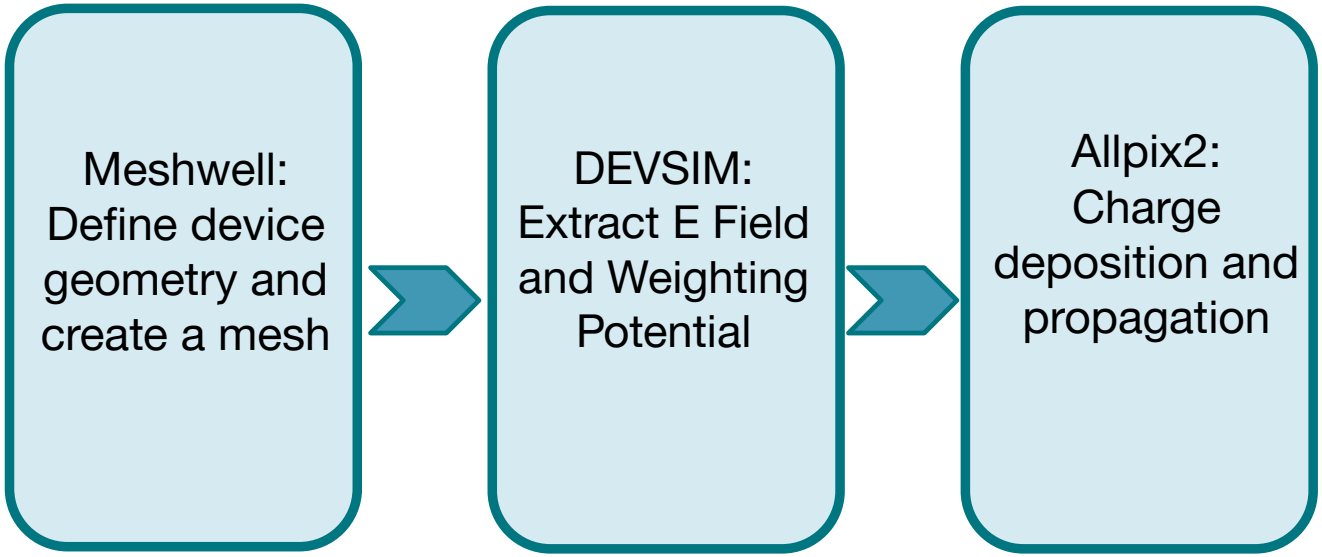
- Investigating amorphous indium gallide zinc oxide (a-IGZO) and amorphous Silicon (a-Si)
- a-IGZO is promising due to its high mobility, e/h pair yield to crystalline silicon, and since it is a majority carrier material
- extremely popular with TFT enthusiasts, deposition processes, material behavior, and reliability are well characterized
- Not traditionally doped!
  - carrier concentration is tuned by controlling the oxygen concentration during deposition



2D slice of current simulated stackup

Simulation Flow

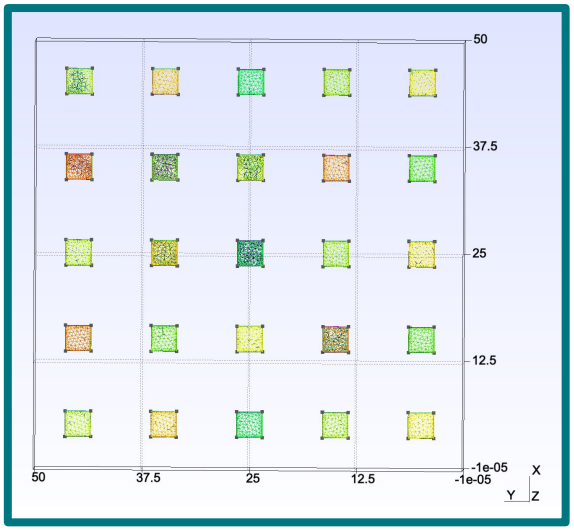
- Have a functional simulation pipeline
  - Material parameters have been pulled from literature



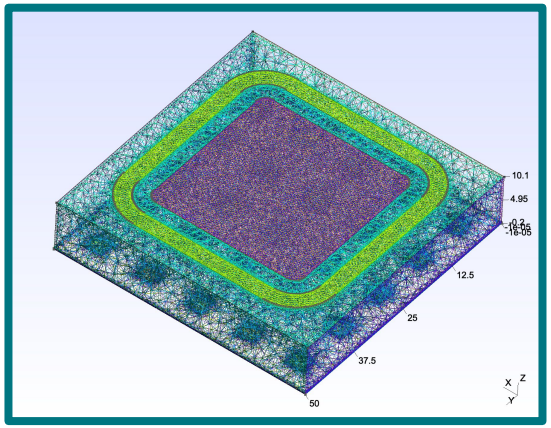
Proposed simulation flow

Meshwell

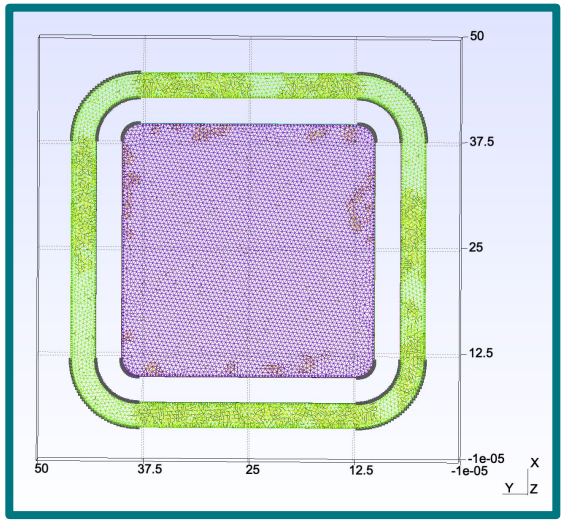
- Open source finite element mesher very similar interface to GMSH
- Supports adaptive meshing, finer at interfaces and coarser throughout the bulk



Cathode bumps representing the readout chip contacts



Complete device generated using Meshwell



Platinum anode and guard ring

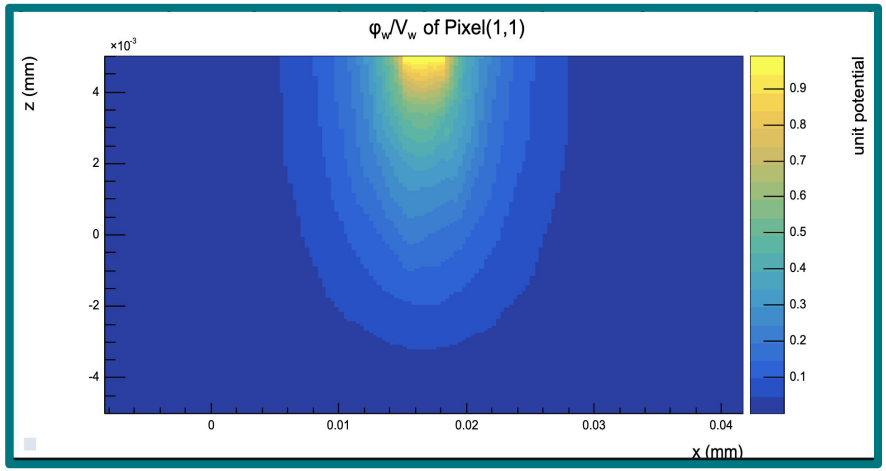
DEVSIM

- Open source TCAD software – good alternative to commercial TCAD
- Import mesh, assign material parameters and boundary conditions, and ramp to applied bias
- Extract the electrostatic field and the weighting potential and then send through Allpix²
  - Allpix² supports custom TCAD fields in DF-ISE file format, custom script needed to convert files

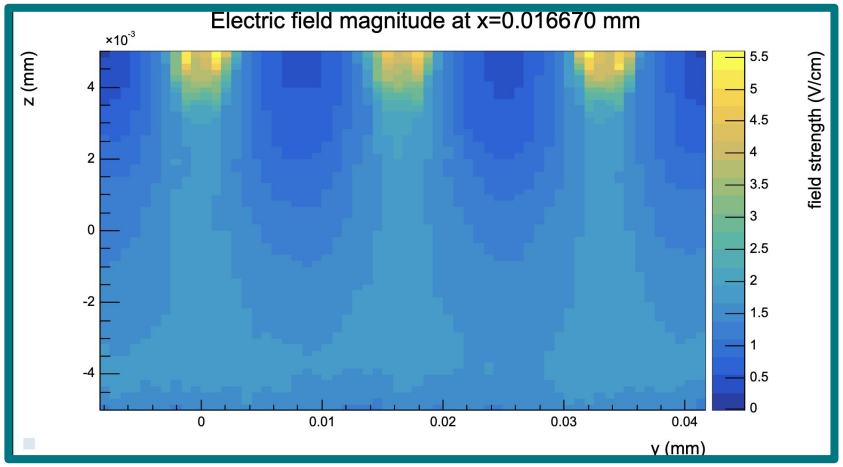
Allpix²

- Takes in weighting potential and electric field
- Handles charge deposition and the drift-diffusion of charge carriers

Weighting potential and electric field from DEVSIM read by Allpix²



Weighting potential (xz)



Electric field mag (yz)

Thank you!