Nanoparticle Assembly Chambers

NTessimal

Tools for novel *AI*, *biotech*, and *multi-function* hardware

AI Hardware Approach Limitations

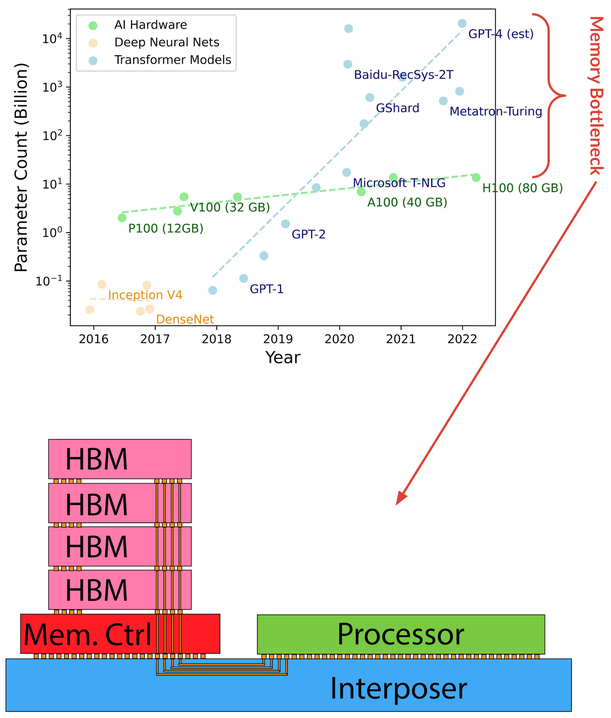
Mathematical Breakthroughs

- Larger AI models offer significant potential to revolutionize most economic sectors
- Current hardware approaches have struggled to keep pace with mathematical advances
  - Increasing die size
  - Increasing integration with packaging
  - Fine tuning architecture

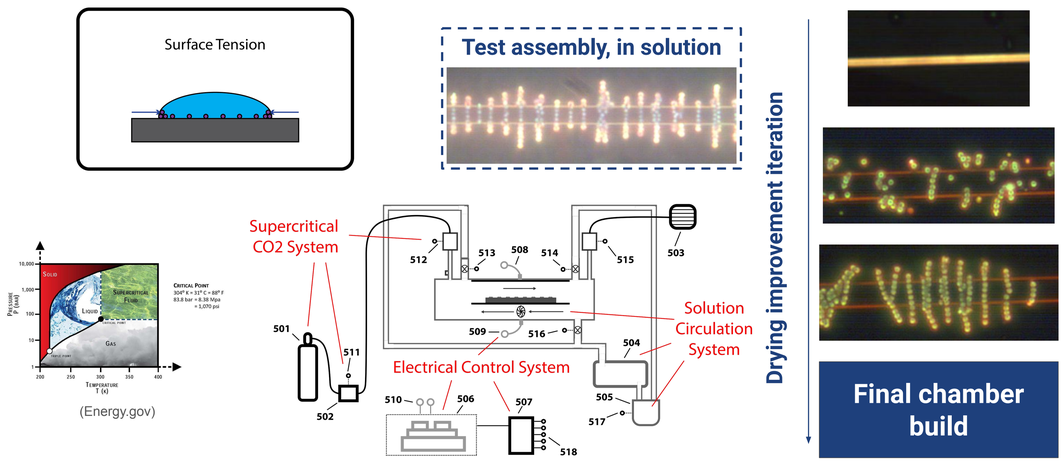
Physical Limitations

- Memory bottlenecks arise from physical fabrication and packaging constraints
- Interconnect pitches and via yield are improving incrementally

A ***faster rate*** of hardware improvement is necessary

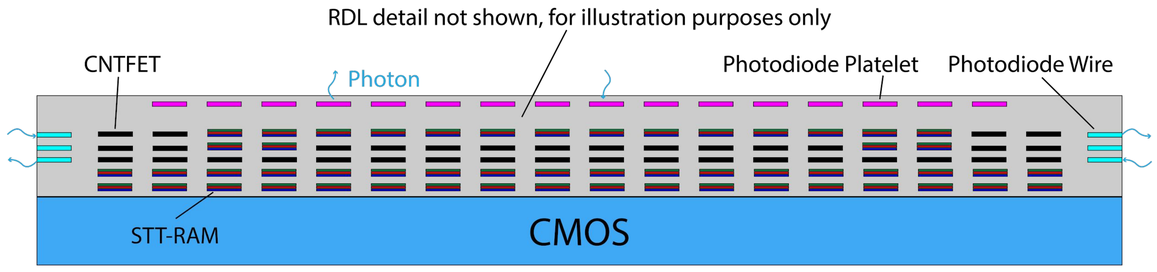


Reducing Disruption with Supercritical Drying

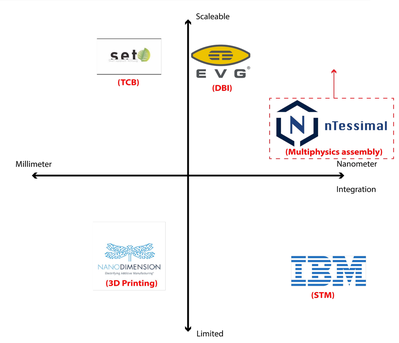


- Surface tension disrupts particles during drying
- Smaller particles, submicron, experience greater disruption
- Our patent pending assembly chamber incorporates in-situ supercritical drying to prevent disruption by movement and Brownian forces
- Supercritical CO_2 mixtures are compatible with appropriate permittivity/conductivity solvents at reasonable pressure/temperature

Evolutionary Device Level Integration



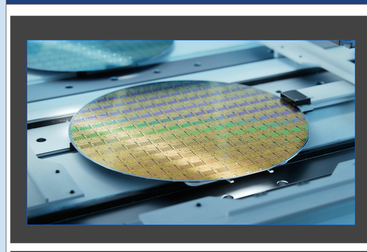
- Nanoscale high density interconnects (nm vs. μm)
  - Near & in-memory computing
  - Higher density, shorter lines
- Larger materials set, fabricated off substrate
  - CNTFETs (~5x switching speed, ~⅛ power)
- Multi-functional die
  - Logic, memory, optical
- True 3D topology



Compatible with existing wafer level processing & larger scale integration

Lithography defined integration allows for a potential ***>1,000x*** improvement over traditional packaging

Industries

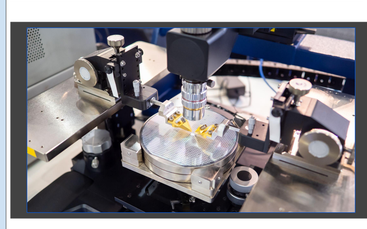


Pure-Play Semiconductor

We received a NSF grant support letter from a semiconductor foundry, Skywater, who understands the value of patterning high purity CNFETs.

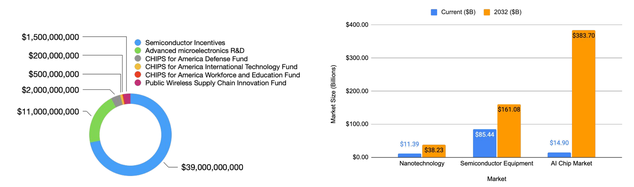
Biotechnology

We received a NSF grant support letter from EtectRx to increase manufacturability of microparticle based monitoring antenna and lab-on-chip solutions.



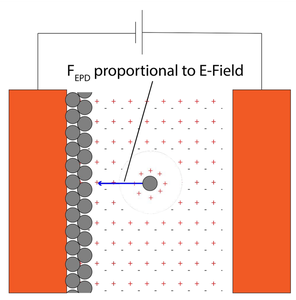
Advanced Substrates

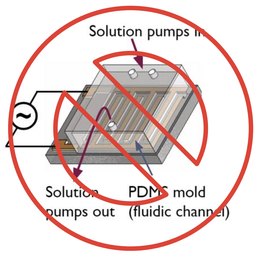
We're working with a glass substrate manufacturer, Samtec, on high aspect ratio via fill including novel materials.



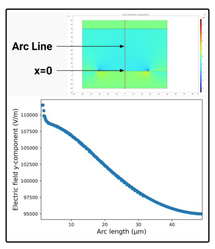
Market growth and incentives bolster semiconductor equipment tailwinds

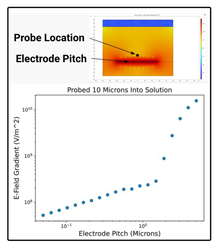
Multiphysics Nanoscale Assembly

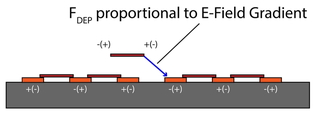


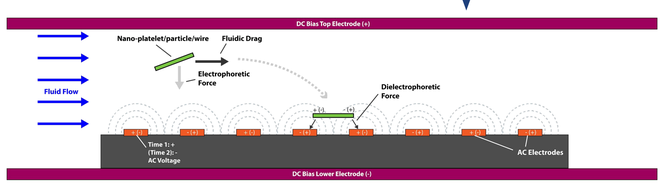


By combining fluidic, electrophoretic, and dielectrophoretic forces we achieve non-contact full substrate assembly









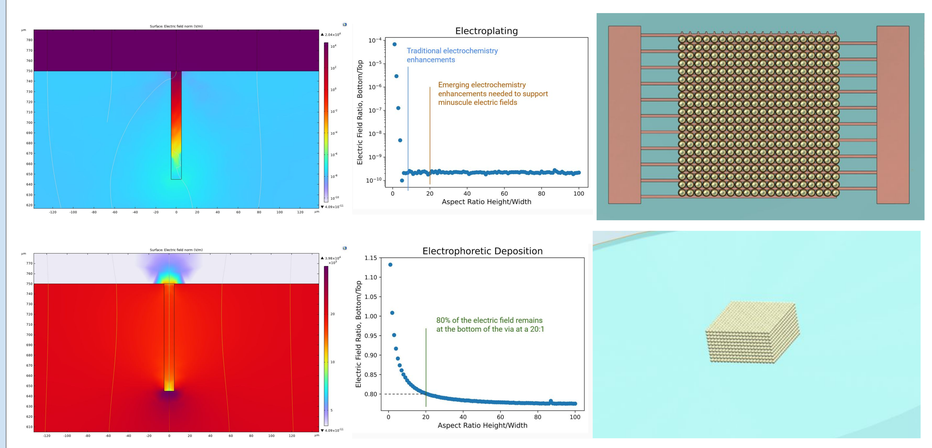
Microfluidic Channels + DEP

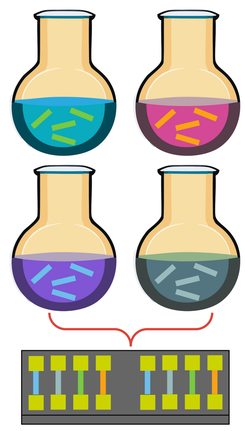
- Decreased patternable area
- Particle contamination
- Requires mechanical movement
- Adhesion loss

Multiphysics Assembly

- Allows full wafer to be patterned simultaneously
- Non-contact
- No movable parts during assembly

Additional Applications





High Aspect Ratio Via Fill

- Larger E-field gradients within via for higher aspect ratio fill
- Greater variety of available materials
  - Non-plateable metals
  - Dielectrics
  - Magnetic materials
  - Composites

Photonics/Plasmonics

- Photonic crystals
- Multi-particle quantum plasmonics
- Can be combined with photo-emitters/photo-detectors

Lab-On-Chip

- Nanowires functionalized off-chip
- Assembled on chip

Cost effective R&D chambers and application support can help customers develop novel IP