How More-Than-Moore technologies impact every day applications

Dr. Jeff Wetzel
Leverage our unique Manufacturing infrastructure, 3-D Integration Technology and Novel Materials expertise to deliver next generation nanotechnology products:

- MEMS/NEMS
- Microfluidics
- Silicon Photonics
- III-V on Silicon
- 2.5D/3D Integration
- Non-Volatile Memory
- High Voltage & RF
- Image Sensors
Technology to Enable Custom Solutions

MEMS, Photonics, III-V, Novel Materials, Microfluidics, etc.

Build novel structures BEOL

Start with FEOL CMOS wafer
Focused on Convergence of 3 Critical Areas

2.5D & 3D Integration
- World’s only Merchant Fab Licensee of Ziptronix Direct Bond technology
- Copper BEoL to support multi-level metal, redistribution, TSV

Heterogeneous Integration
- Hybridization of Silicon and non-silicon (quartz, GaAs, InGaAs, GaN) substrates
- Non CMOS elements – ie: GaN HEMT’s, photonic waveguides, etc

Novel Materials
- More than 60 elements from periodic table can be leveraged in the fab today
- World’s fastest most flexible on-boarding of new materials

Enabling Smart Sensors, Advanced Imagers, RF/Power Electronics
The NOVATI Formula

Various FEOL Wafers + Novel BEOL Processing + Multiple Markets = Innovative Products

- IBM
- GF
- TSMC
- X-FAB
- ON SEMI
- TOWER/JAZZ
- TI
- CYPRESS
- HONEYWELL
- SAMSUNG

MEMS
MICROFLUIDICS
PHOTONICS
2.5D/3D
TSV
NOVEL MATERIALS
CARBON NANOTUBES
SUPERCONDUCTING

AEROSPACE
DEFENSE
LIFE SCIENCES
HEALTHCARE
CLEAN ENERGY
CONSUMER
TELECOM
DATACOM
INDUSTRIAL

IR IMAGERS
DNA SEQUENCING
3D ULTRASOUND
DRUG DELIVERY
NON-VOL MEMORY
INKJET PRINTERS
SENSORS
GaN-on-SILICON
InP-on-SILICON
POWER DEVICES
Application to Sensors

- Optimize Digital, Analog, Sensor performance individually
- Ability to select KGD for bonding to sensor wafer
Heterogeneous Direct Bonding

**DBI® Technology**

- Room temperature, hermetically (MIL 883E) sealed direct bonding of insulators, Silicon, III-V and other dissimilar materials with conductive interconnects
- Scalable down to less than 1 micron pitch
- Leverages industry standard CMOS equipment processes
- In-situ, scalable 3D interconnect with direct oxide bond
- Maximizes the density of signal paths use to interconnect transistors and other components between stacked devices
- Lower cost, next generation 3D backside illuminated image sensors with < 2 micron 3D interconnect pitch between pixel and control layers have already been demonstrated
III-V Integration on Silicon

GaN on Si

- CD ≤ 0.25um
- Cu BEOL
- Non-Au ohmic contacts
- Integrated BE MIMCAPs and Resistors

- Metal-bonded III-V chiplets for integrated Modulators and Lasers
- III-V etch
- Si waveguides
- Advanced gap-fill, CMP
- Exotic contact metals
- MEMS-sized film thicknesses

InP on Si
Novati Facility in Austin, Texas

- 110 Employees: 90 in Ops and Engineering
- Over 150 production grade tools
- 68,000 sq ft Class 10 clean room
- 24/7 operations & maintenance
- Manufacturing Execution Systems (MES)
- IP secure environments, robust quality systems
- ISO certified/ITAR registered
- Full-flow 200mm silicon processing, 300mm back-end (Copper/Low-k)
- Process library with > 25000 recipes
- Novel materials (ALD, PZT, III-V, etc)
- Copper & Aluminum BEOL
- Contact through 193nm lithography
- Silicon, SOI and Transparent MEMS substrates
- Electrical Characterization and Bench Test Lab
- Onsite analytical tools and labs: SIMS, SEM, TEM, Auger, VPD, ICP-MS, etc
What Novati Provides

• Smaller, flexible, leading edge Semi/MEMS nanofabrication partner essential for rapid development/commercialization
  – Leading edge delivers
  – Industrial scale connectivity matters

• Much easier to transition to production
  – Our process is viable (no “weirdness”)
  – NRE is lower

• Universities and research institutions are great for *applications research, but*...
  – Industry provides industrial technology, rapid productization
  – Moves researchers up the value chain