

## FDC CAPABILITIES

*Comprehensive Flexible Electronics Capabilities* that bridge the high risk, resource intensive gap between innovation and product development in an information-secure environment.

### Sponsor Services:

- Integrated Circuit (IC) Design, Development and Fabrication of Inorganic and Organic Thin Film Transistor Arrays
- Design for Manufacturability with High Yield and Optimal Circuit Performance
- Early Stage Prototyping and Low-Volume Production (e.g., 1000 units/yr.)

### Facility:

Located in ASU Research Park, Tempe, Arizona, the FDC is a world-class facility with 25,000 sq. ft. of Class 10/100/1000 Fabrication Clean Rooms and 12,000 sq. ft. of Class 10,000 and nonrated wet/dry labs with the following Pilot Line Fabrication Capabilities:

- 1) 6-Inch (150 mm) Wafer-scale Pilot Line for Research and Development (3 micron feature size (L/S))
- 2) GEN II (370mm x 470 mm) Pilot Line for Low Volume Production (3 micron feature size (L/S))

Both Pilot Lines are linked to a Manufacturing Execution System (MES) for Efficient Lot Management and Statistical Process Control (SPC)

### Electronic Design Automation (EDA) for IC Design, Modeling and Simulation: Prof. David Allee, Director

- Professional Suite of Flexible / Large Area Microelectronics Design Tools:
  - Circuit Simulation
  - Design Rule Checking (DRC)
  - Layer Verification (LVS)
  - Layout
  - AutoPlace and Route with *Standard Cell Library Development Capability*
- State-of-the-Art a-Si:H Transistor Models including VT Shift
- Extensive Suite of Digital and Analog Circuit Testing Equipment

### Fabrication Processes: Shawn O'Rourke, Director

1. Substrate Materials: Si, Glass, PEN, Stainless Steel (SS)
2. Photolithography: GEN II Scale Automated Distortion Compensation for Plastic Substrate Materials (PEN)
3. Deposition:
  - Physical (sputter) Vapor Deposition (PVD): Al, Mo, ITO
  - Plasma-Enhanced Chemical Vapor Deposition (PECVD): a-Si, n+a-Si, SiN, SiO<sub>2</sub>, SiON
4. Etch: Dry and Wet
5. Solution Processing: Spin-on Glass (SOG), PI, Benzocyclobutene (BCB); (6-in. line only)
6. Analytical Techniques and Materials Testing (\*GEN II Compatible):
  - Ellipsometry\* for film thickness and optical properties
  - White Light Interferometry for optical surface profile
  - Atomic Force Microscope (AFM) for film thickness and surface roughness
  - Step Height Profilometer\*
  - Film Stress\*
  - Four Point Probe
  - Fourier Transform Infrared Spectrophotometer (FTIR)
  - Wafer Flatness: Bow and Warp
  - Critical Dimension (CD) Measurement\*
  - Field Emission Scanning Electron Microscopy (FESEM) for surface morphology
  - Focused Ion Beam (FIB) – Tempe Campus

**Electrical Testing:**

- Automated transistor and PCM testing
- Automated TFT array test

**Reflective and Emissive Display Integration and Characterization**

- Display and Flexible circuit design
- Display simulation and modeling
- Flexible circuit simulation and modeling
- Display and Circuit layout
- Display Tooling layout (masks, fixtures, hardware)
- Electro-optic design and modeling
- Display packaging and assembly
- High density interconnect assembly
- TAB, COF, COG Assembly
- Final Display Test
- Display Characterization: Eldim EzLite, PR670, Minolta CA2000
- Display Design Verification and Test Structures
- Demonstrator Design and Hardware

**Flexible and Organic Electronics Development Laboratory (FOEDL):** Prof. Ghassan E. Jabbour, Director

- OLED Materials Optimization: Small Molecule, Phosphorescent, Fluorescent and Macromolecules
- Encapsulation: liquid and vacuum-based approaches
- OTFT Materials Characterization:
  - Bottom and Top Contact Devices
  - Transistor materials: Small Molecules, Conjugated Polymers, Hybrid Inorganic/Organic structures, Molecular nano-tube based coatings and transparent inorganic-based TFTs.
  - Gate Insulators: Organic: PMMA, PVP, photoresist, various resins; Inorganic: SiO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub>, TiO<sub>2</sub>
  - Contacts: Organic: PEDOT: PSS, PANI; Metals: Gold, Silver, Aluminum, others
- Photomask Aligner (6-in., 25 substrate cassette)
- 8-in. Spin Coater (Controlled Atmosphere)
- Blade Coater
- Inkjet Printers: Dimatix Piezoelectric Inkjet, Litrex (4-cartridges), HP and Cannon heat (bubble) inkjet technology
- Reactive Ion Etcher (RIE): oxide or nitride
- Atomic Force Microscopy (AFM): tapping mode and contact mode for surface topography, Tunneling AFM (TUNA) and scanning tunneling microscopy (STM) for conductivity measurements; and Nanoman with nanoindentation, nanolithography and nanomanipulation (carbon nanotubes); and tapping mode in liquid (biomaterials)

**Related ASU Research Programs and Capabilities:**

- Center for Solid State Electronics Research (CSSER): Nanostructures - Molecular Beam Epitaxy and Optoelectronics; Materials and Process Fundamentals; Low Power Electronics, Bio & Molecular Electronics; MEMS & Nano-fluidics; High-K Dielectrics & Nano-magnetics
- WINTech: Wireless Integrated Nanotechnologies, incl. communications components, telemetry, antennas
- BioDesign Institute at Arizona State University:
- Photonics: IR Displays
- MEMS: Capacitive Sensors and Accelerometers
- Center for Advanced Photovoltaics
- Center for Solid State Science (CSSS)