American Semiconductor®

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Enabling Flexible Electronics

February 9, 2016

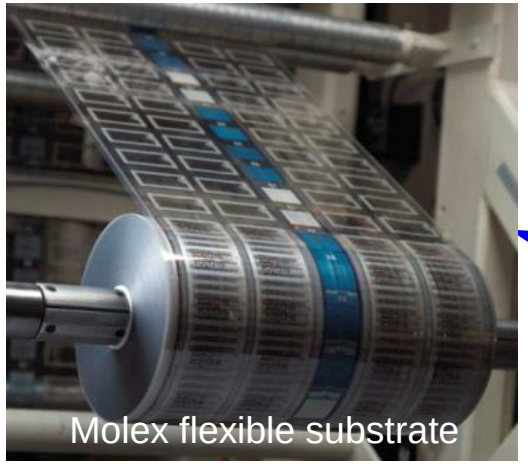
OE-A Workshop

Boise, Idaho

American Semiconductor®

What are Flexible Hybrid Electronics?

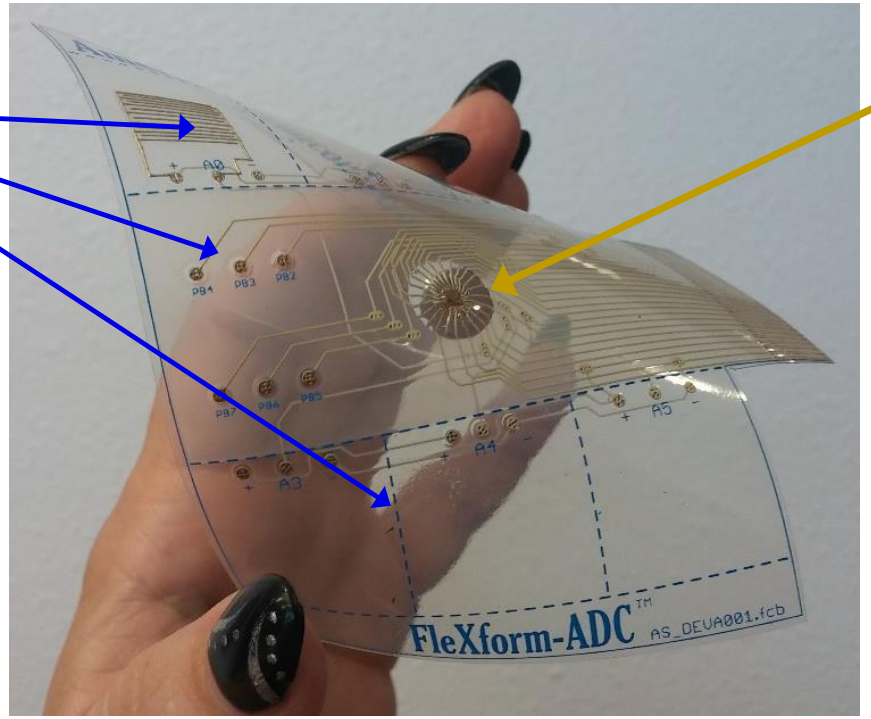
Printed Electronics
Low Cost, R2R, Large Format


Molex flexible substrate

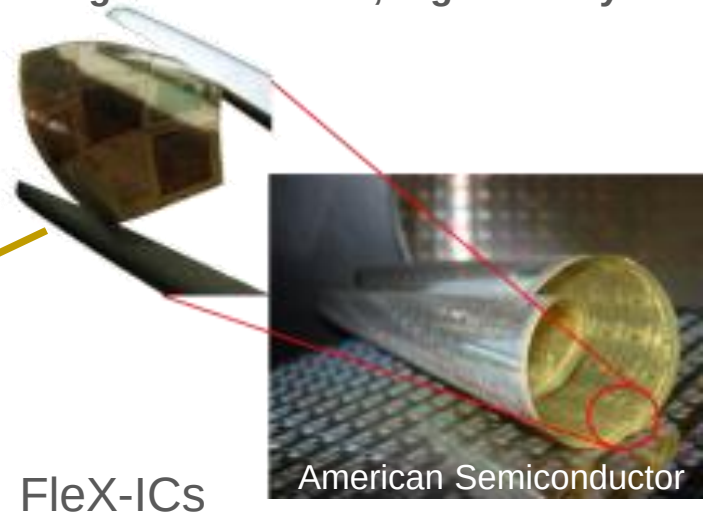
Printed Electronics
- Sensors
- Interconnects
- Substrates
- Displays

- Low Cost, Large Format
- Roll-To-Roll, Screen, Inkjet Print, …

Flexible Hybrid System
"Combination of flexible printed materials and flexible silicon-based ICs to create a new class of flexible electronics."



Flexible *FleX*-ICs
High Performance, High Density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FleX-ICs
- Sensor Signal Processing
- Data Processing
- Data Storage
- Communications

- Low Cost, High Performance
- Compatible with Printed Electronics
- Foundry CMOS + FleX Processing

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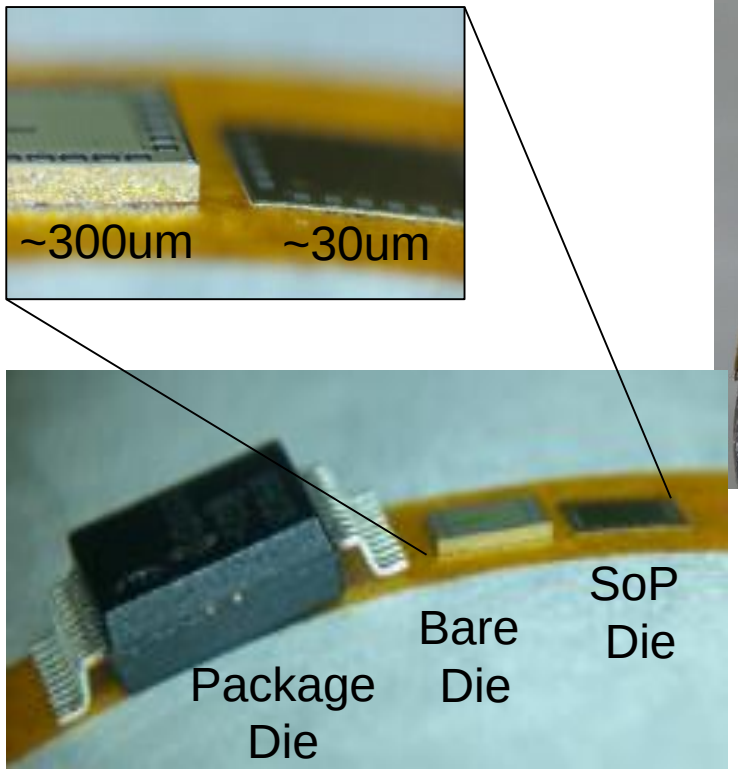
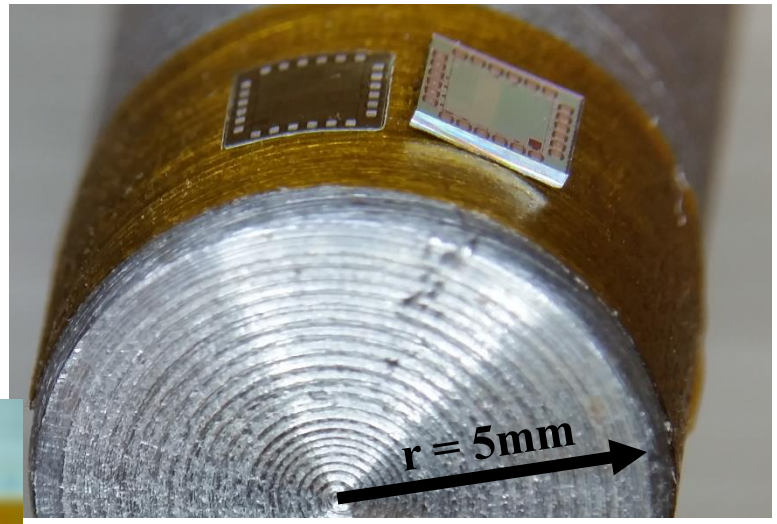
FleX-ICs required to achieve a fully flexible system

- Traditional packaged parts and bare die can be surface mounted to flexible substrates
  - Create rigid “islands” in flex substrates and/or
  - Rigid parts delaminate with even gentle curvature





Flex Op-Amp functions at 5mm radius of curvature!

Test Setup:

Vdd = 2.5V

Vss = 0V

Ibias = 10uA

In-pos = 1kHz square wave (YELLOW trace on oscilloscope)

In-neg = connected to **Out**, voltage follower configuration (BLUE trace on scope)

Out= connected to **In-neg**, voltage follower configuration (BLUE trace on scope)

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Customers and Collaborators

BOEING

3M

BINGHAMTON UNIVERSITY
State University of New York

nbmc
Nano Bio Manufacturing Consortium

FlexTech Alliance
for Displays & Flexible, Printed Electronics

oe-a

NORTHWEST NAZARENE UNIVERSITY

NEXTFLEX
America's Flexible Hybrid Electronics Manufacturing Institute

Honeywell

PAKSENSE

U.S. DEPARTMENT OF ENERGY

brewer science

NASA

soligie
Printed Electronics by molex

GE Global Research

Northeastern University

University of Idaho

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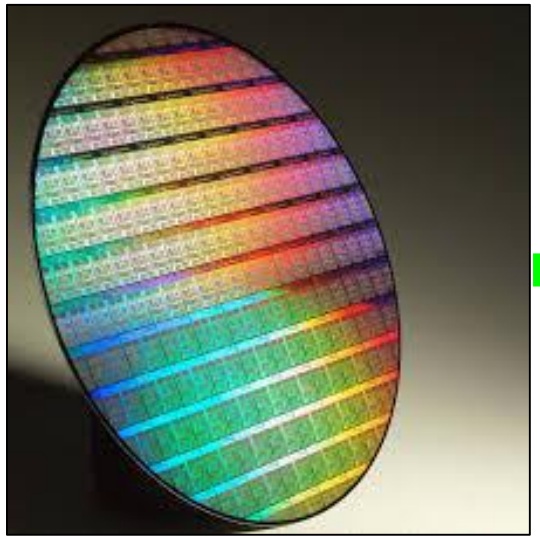
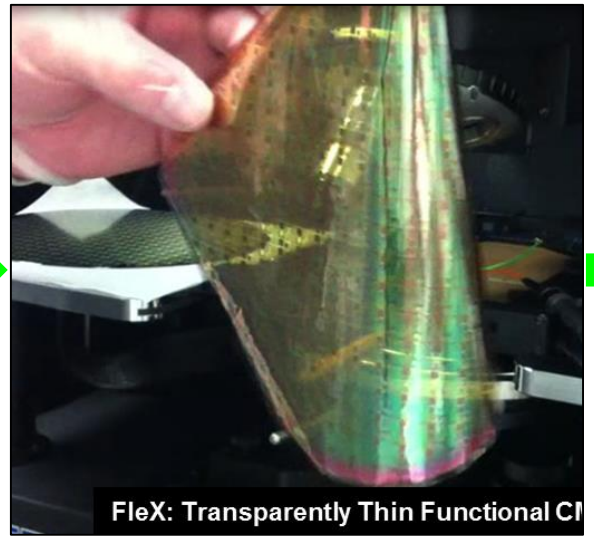
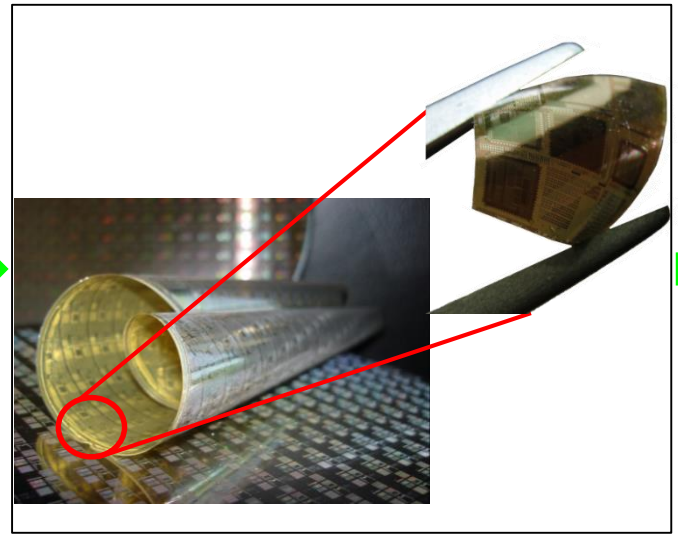
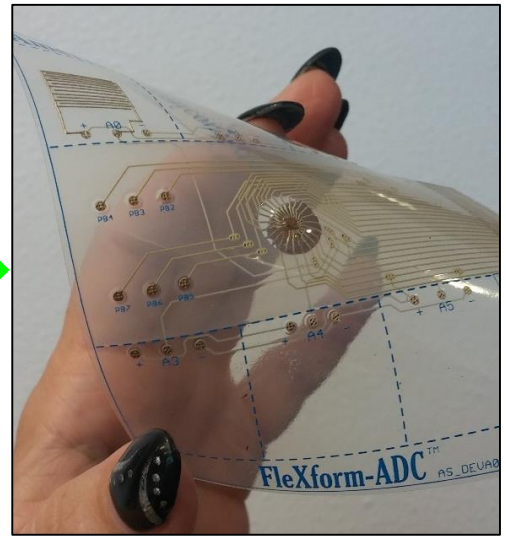
Our patented Semiconductor-on-Polymer process converts conventional semiconductor wafers into ultra-thin ICs that can bend like paper while still providing the high performance logic and high density memories necessary for flexible hybrid electronics systems.









We have developed industry-leading capability for die attach and electrical interconnects to integrate FleX-ICs with printed electronics to create Flexible Hybrid Electronics.

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New Boise, Idaho Facility – Headquarters and Manufacturing

- Small Business
- Privately Held
- Founded Nov. 2001

Member:

oe-a

FlexTech Alliance for Displays & Flexible, Printed Electronics

nbmc Nano Bio Manufacturing Consortium

NEXTFLEX America's Flexible Hybrid Electronics Manufacturing Institute

IDPEG.ORG

9,000 s.f. FHE Manufacturing Facility

Flexible Hybrid Lab

Class 100 Cleanroom

- Flexible Hybrid Assembly
- IC Design
- Antenna Design
- ***FleX***-ICs

- Thin Wafer Processing
- FHE System Integration
- Failure Analysis
- FleXform™ Dev Kits

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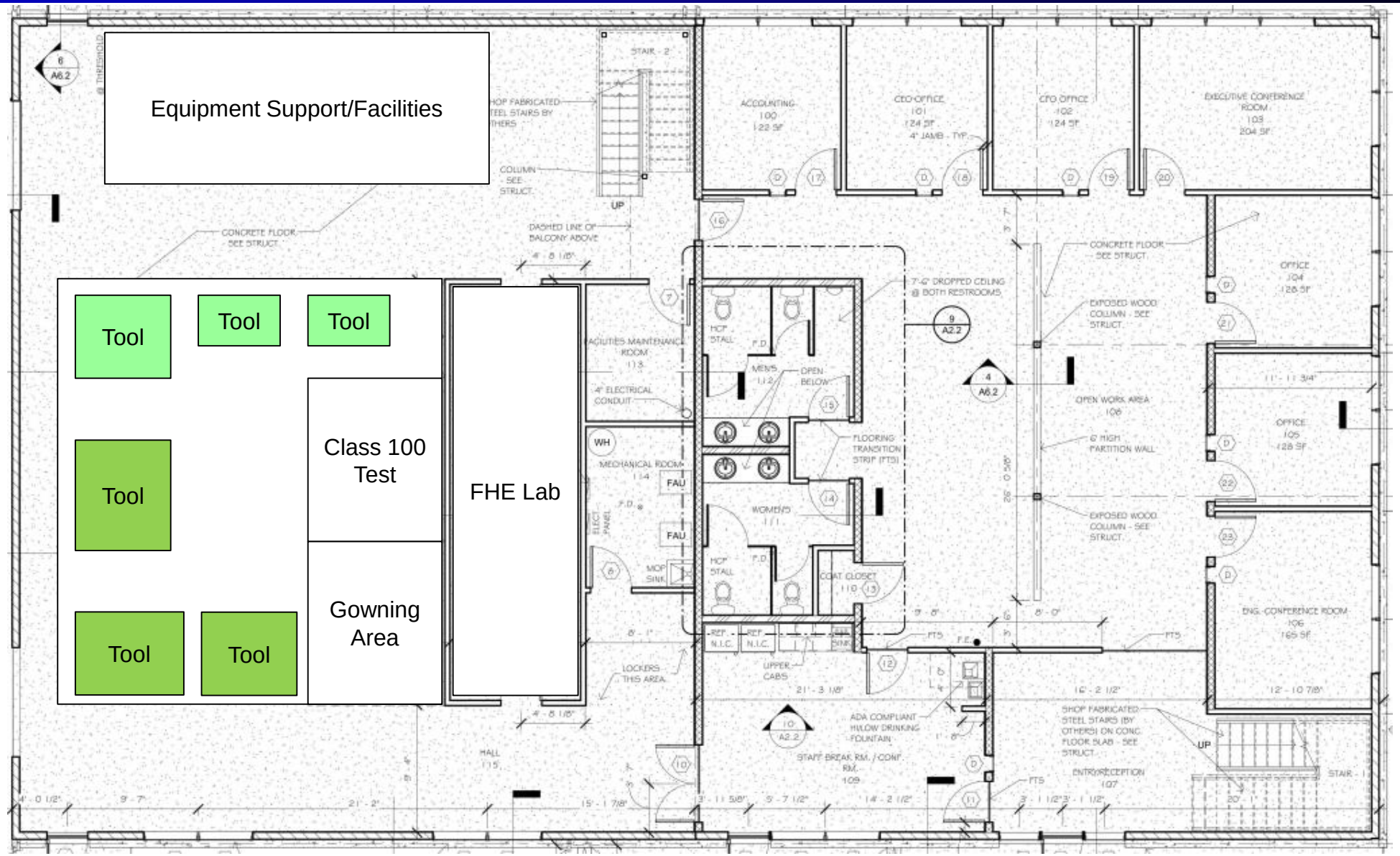
Boise Facility Production / R&D



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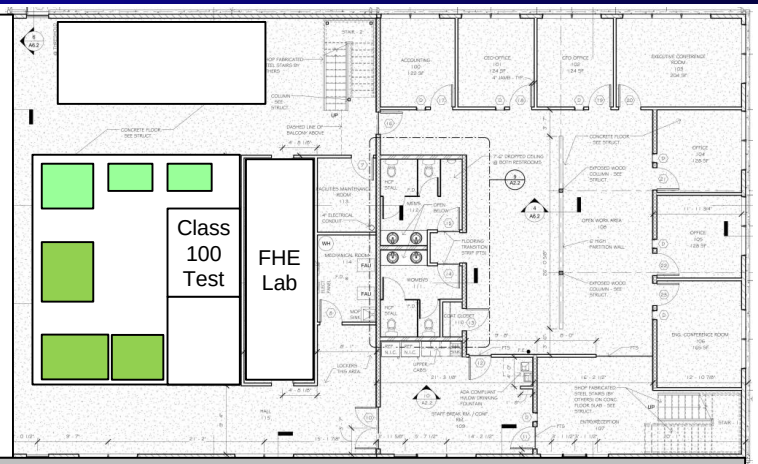
Boise Site Expansion

Production Expansion



Parking

Production Expansion

Office
Expansion

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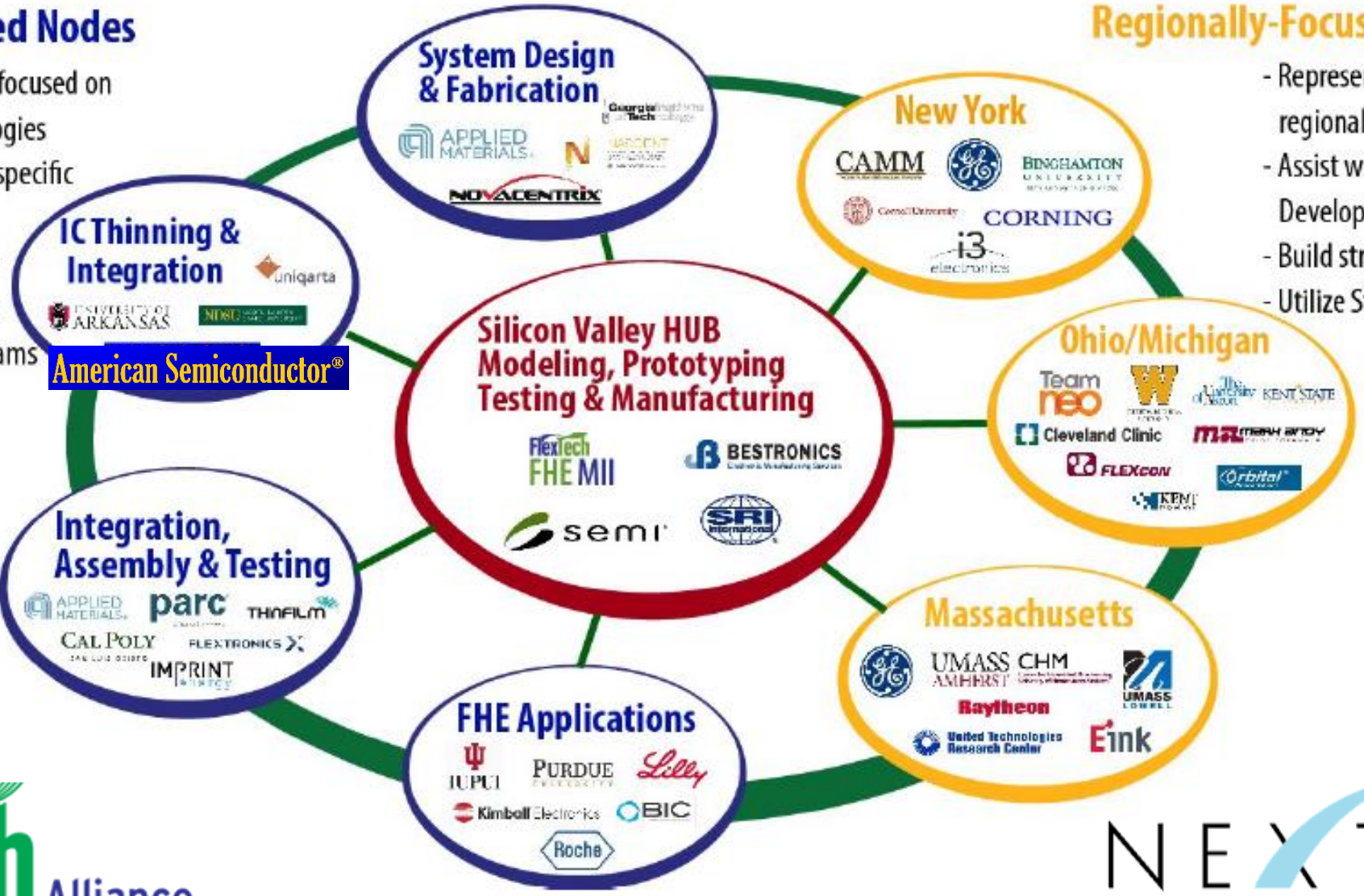
FHEMII
Flexible Hybrid Initiative

Technology-Focused Nodes

- Groups of organizations focused on complimentary technologies
- Able to assist with tech-specific roadmaps
- Assist with tech-specific Workforce Development
- Build strong proposal teams



Regionally-Focused Nodes

- Represent FHE MII interests regionally
- Assist with regional Workforce Development initiatives
- Build strong proposal teams
- Utilize State cost share

FlexTech Alliance

flextech.org

nextflex.us

NEXTFLEX

America's Flexible Hybrid Electronics Manufacturing Institute

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Thank You

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Killer Apps – What are they?

Products are starting to emerge

- Asset Monitoring Systems for structural, quality, and performance
- Wearable monitoring for Medical and Performance
- Consumer product safety, new features.

Today → Future

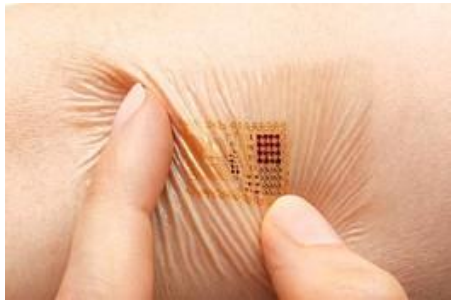
Source: PakSense

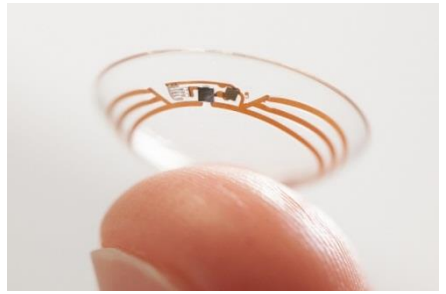
Source: Phase IV

Source: American Semiconductor

Next Generation Fully Flexible?

Source: Fitbit


Source: Univ. of Illinois


Source: Google

Source: Thin Film

Next Generation FHE?

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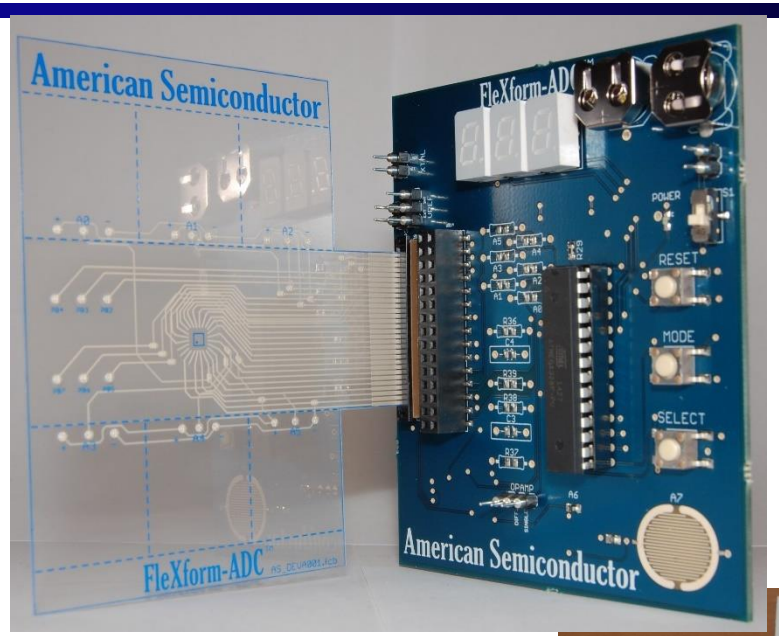
FleXform-ADC™ Development Kit

FleXform-ADC Kits provide:

- **SOTA FHE System**
- **Supports printed sensor development**
- User printable FHE with on-board FleX-ADC™
- Integration Board and Software
- Enables printed device demonstrations
- Fully supported by ASI flexible technology integration team for design and manufacturing



This work sponsored in part by
Air Force Research Laboratory

FleXform-ADC Kit contents:

- Quick Start Guide
- FleXform-ADC printed circuit board (PCB)
- Two button cell batteries
- One 8.5” X 5.5” flexible circuit board sheet with two instances of the FleXform-ADC flexible circuit board (FCB)
- Additional documentation, videos and software development tools are available for download

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