Collaboration for Breakthrough Innovation in Human Performance Monitoring for the Warfighter

NDIA 2018 Human Systems Conference

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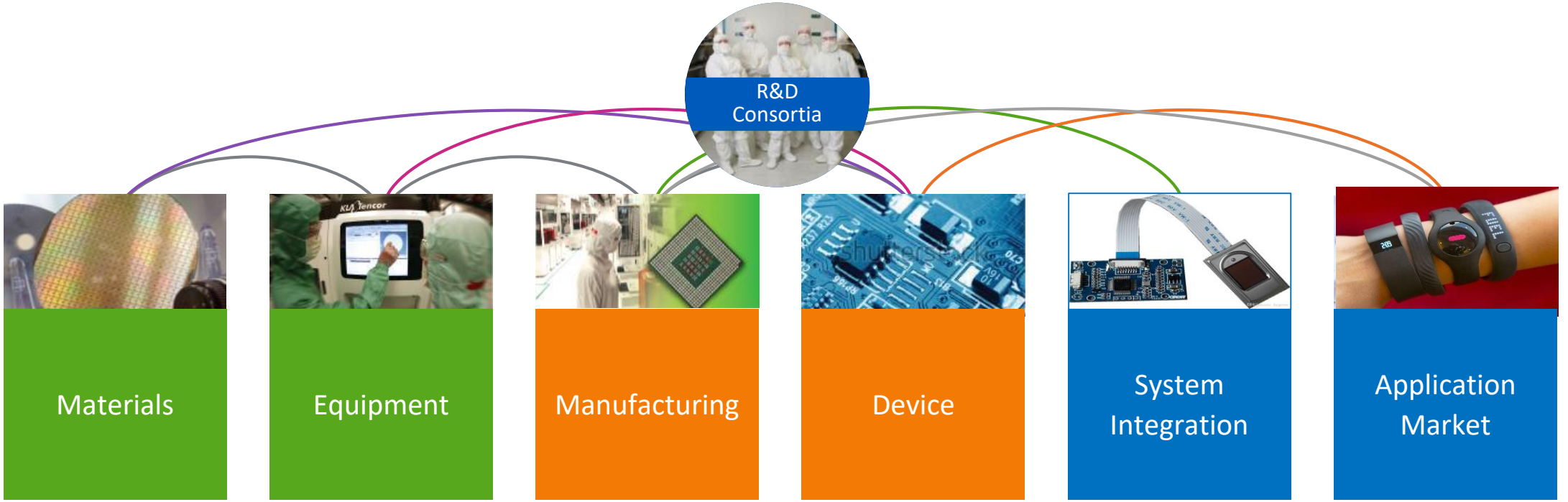
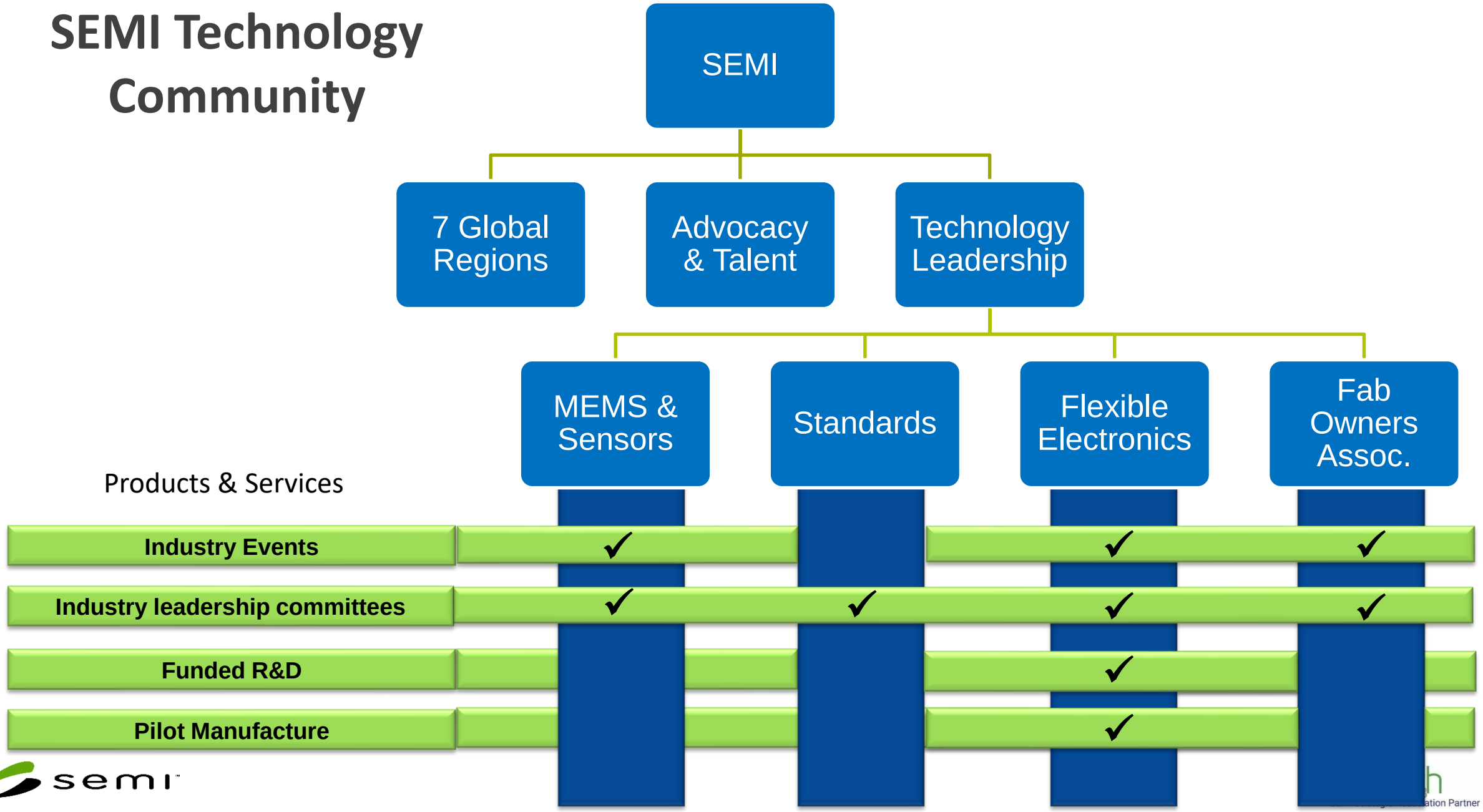
SEMI: Connect, Collaborate, Innovate

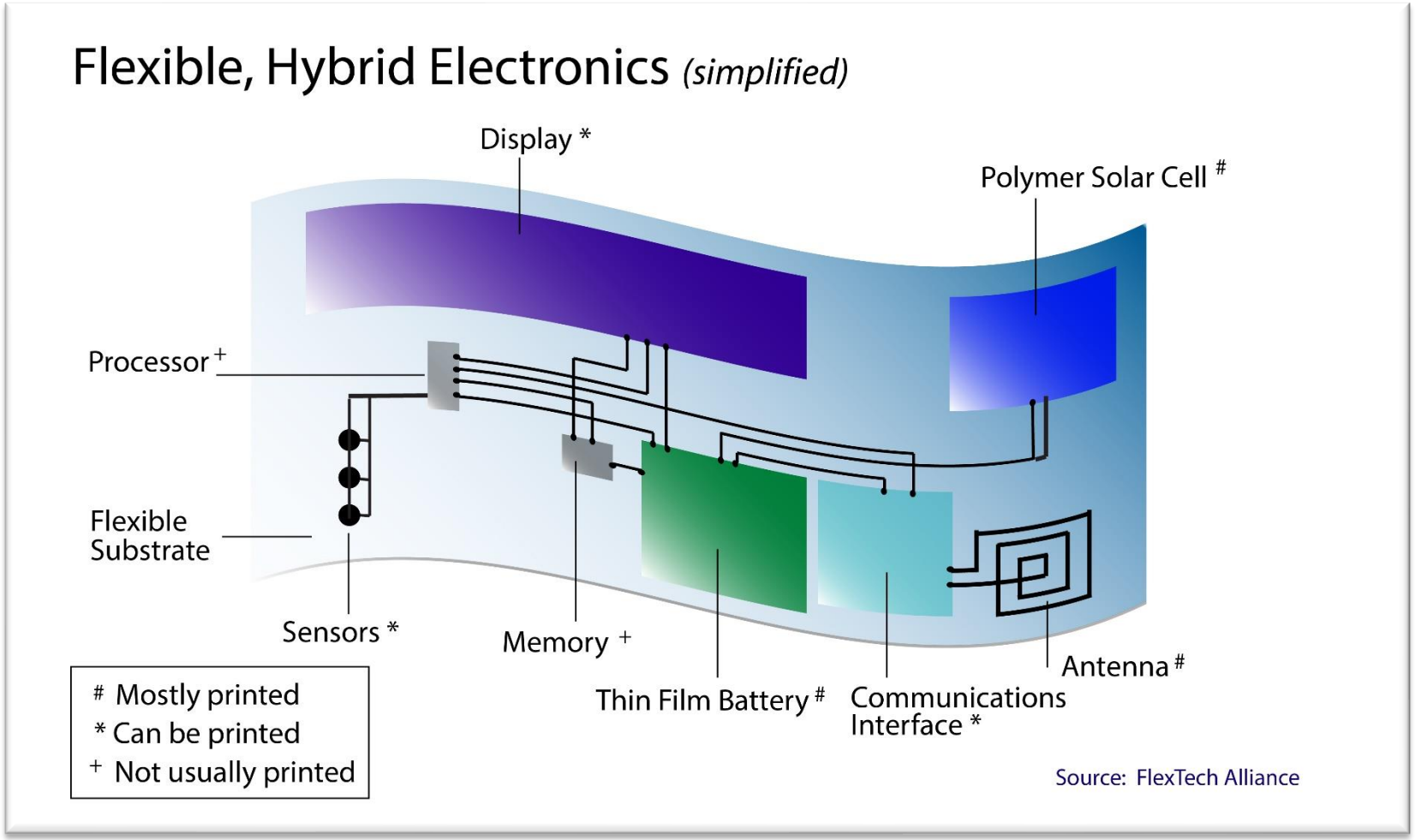


- Collaboration is critical to solving issues and innovating new products
- What's needed for breakthrough applications is almost invisible upstream in the supply chain
- Collective focus on challenges and opportunities shortens time to market

SEMI Technology Community



FHE System Schematic



Mostly Printed

- Interconnect
- Antenna

Can Be Printed

- Power
- Display
- Communication Interface
- Sensors

Not Usually Printed

- Processor
- Memory
- Medium to far field communications and location
- High performance circuits

SEMI • FlexTech Activities

Mission: Create a collaborative environment to accelerate the risk reduction of technology, manufacturing, and supply chain development

Flexible Hybrid Electronics Supply Chain Development	Flexible, Wearable Human Performance Monitoring	Flexible Hybrid Electronics Manufacturing
FlexTech	nbmc Nano-Bio Manufacturing Consortium	NEXTFLEX America's Flexible Hybrid Electronics Manufacturing Institute
• CMOS Integration • Radio and communications • Sensing, warnings, wearable displays	• Human Performance Monitoring Applications • 20+ members	• Manufacturing Gaps • Public-private partnership • 50+ members
ARL	Air Force Research Laboratory	Manufacturing™ USA

Projects & Partners

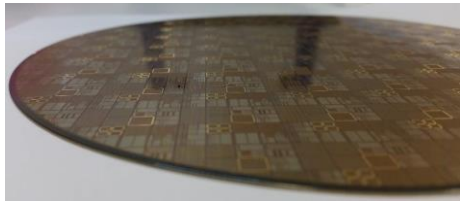
Sensor Systems	Materials	Power	Hybrid Integration	Design & Integration
Wearable Devices for Dynamic Assessment of Hydration & Hydrogen Status		Biometric Sensors - Integrated Development Platform for Human Performance Monitoring		Flexible Electromagnetic Field Sensing Array
Wearable Flexible Hybrid Electronics Biometric Performance Monitor		Printed Microfluidic Performance Assessment for Sweat-Based Biomarker Sensor Platforms		Self-Powered Communicating Sensors
Design & Fabrication of Prototype Biosensor Monitoring Devices			A Scalable Flexible Substrate and Assembly Process	Sensor Labels
Microfluidics System Packaging		Flexible Printed Electronic Device		Flexible Printed Battery
Wearable Dynamic Hydration Assessment System		Materials Registry		Thin Film Power Source
				Solid State Thin Film Lithium Rechargeable Battery

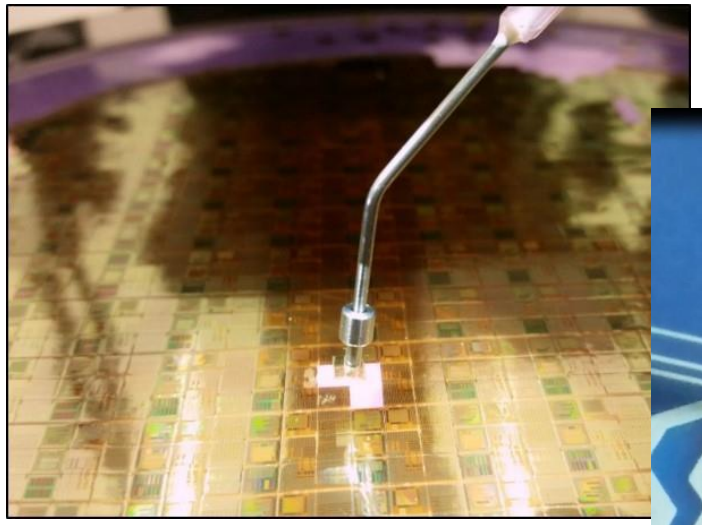
Flexible Silicon

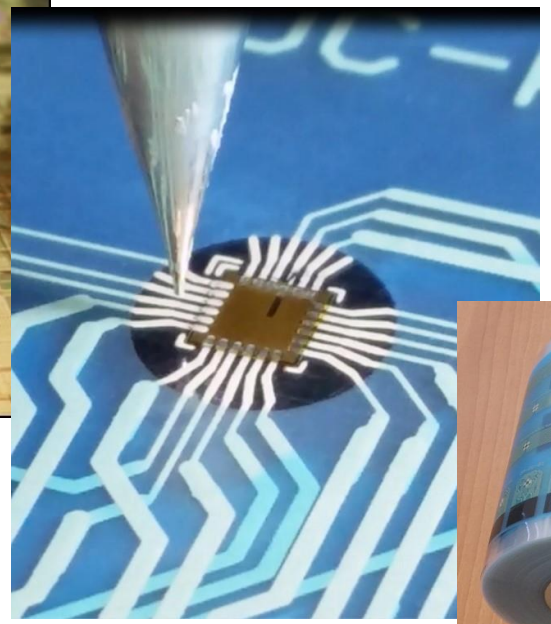
American Semiconductor Inc.

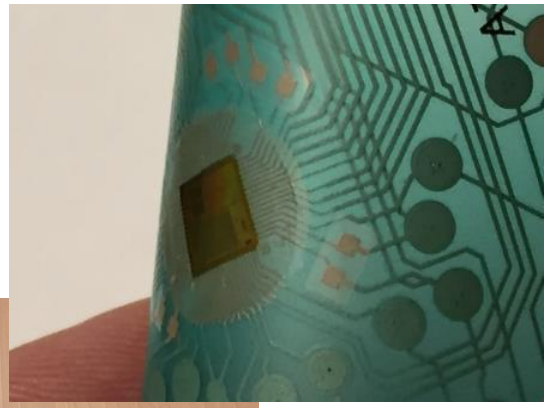
molex
one company › a world of innovation

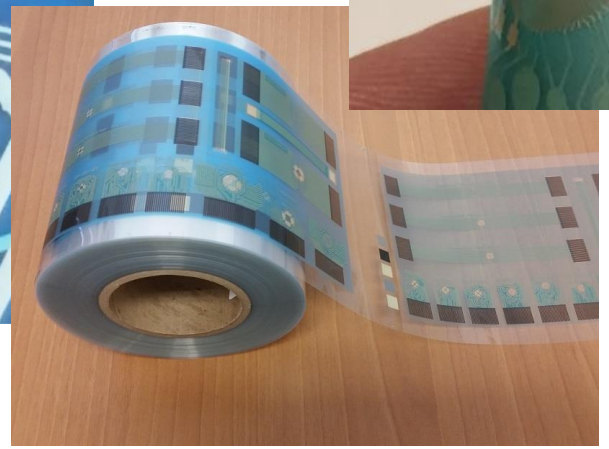
Ultra-thin CMOS
Assembly & multi-layer flexible PCB











CMOS wafer prep

Pick & Place
25 micron total packaged thickness

3D Additive Interconnection
additive print interconnect

Roll to Roll Manufacturing
✓

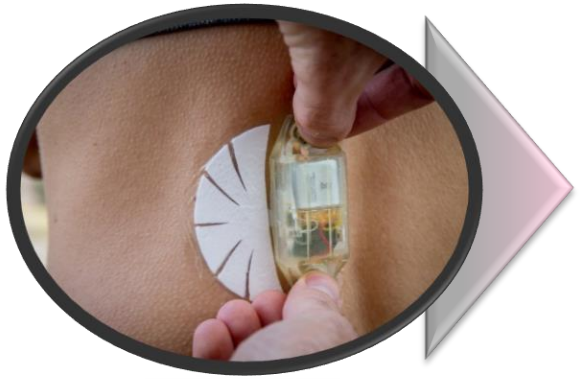
Program supported by:

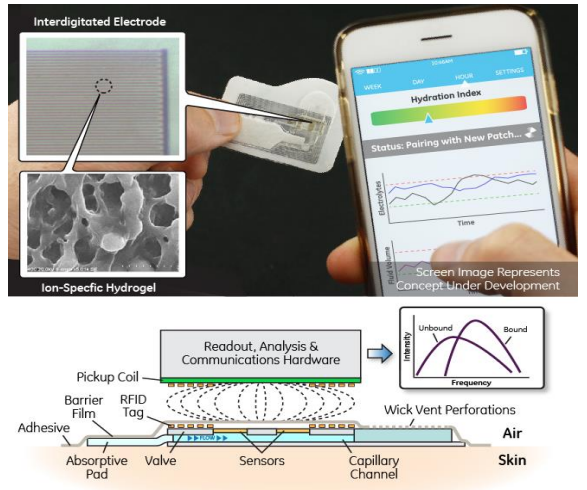
semi

FlexTech
SEMI Strategic Association Partner

Wearable Performance Monitor

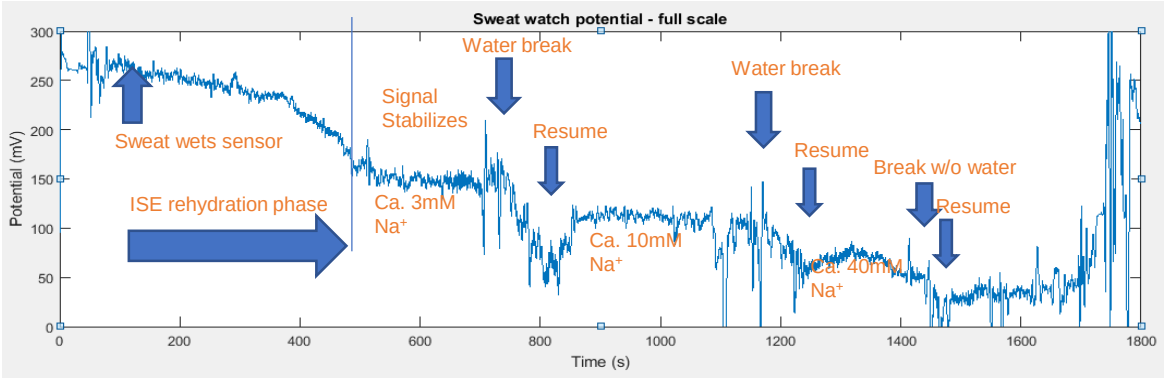
Objective: Develop Flexible, Non-invasive Wearable for Dynamic Assessment of Hydration Status





NBMC Consortium Project 16-10: A Collaborative team of 7 industry and university members lead by GE developed

1. Ion Selective Electrodes – Na+ and K+ concentration in sweat
2. RF Impedance Patch – subcutaneous hydration tomography and spectroscopy



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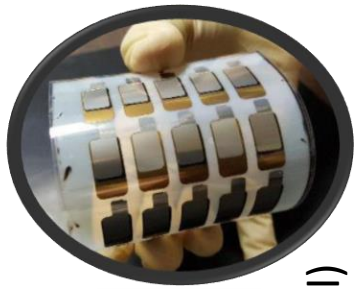
Thin Flexible Power Source



ITN Energy Systems Inc. | ENrG Inc. | Lucintech Inc.

Power Module Integration + Advanced Materials + Photovoltaics

Energy Density (Wh/l)

1000
800
600
400
200
0

Self-recharging
Ultra-thin
Power Pack

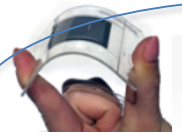
Primary & rechargeable battery
Capacity 30-90 mAh

Adv. Packaging & Integration

Printing & Lamination

Primary battery
Capacity 30-1000 mAh

Imprint



Panasonic

200 400 600 800 1000

Packaged Battery Thickness (microns)

Program supported by:

semi

FlexTech
SEMI Strategic Association Partner

Medical, Health and Wellness Applications

Cognitive Function

- Military, consumer, industrial, and athletics
- High value assets, safety, performance

Telemedicine

- Vital sign and geriatric patient monitoring
- Reduced health care costs
- Continuous measurement capability

Treatment Response

- Reduce treatment cycle times
- Reduced costs
- Lower mortality rates

Aeromedicine

- Coordinated triage
- Continuous vital sign monitoring
- Variable / austere environment

Performance Monitoring

- Improved health and wellness
- Athletic performance enhancement

Monitoring Requirements

- Cost effective
- Unique accuracy & precise
- Low maintenance
- Automated analytics

Summary

- Target the needs of the military – sustaining and augmenting peak performance of the military personnel
- Align to commercial industry advances and ecosystem development to ensure a stable and advanced supply chain
- Take advantage of other disruptive technologies and address the challenge of incorporating into flexible electronics
  - Artificial intelligence and machine learning
  - Edge computing and new SW/HW architectures
  - Advanced MCU-memory-sensor interfaces
  - Multi-modal sensor data acquisition and management

Thank You

SEMI Strategic Association Partner