Agenda

- Introduction and Background
- A New Era in Electronics
- Importance of a Manufacturing Infrastructure
- Customer Pull
- FlexTech’s R&D Program and Industry Building Activity
- Summary
What is the FlexTech Alliance?

• FlexTech Alliance is a North American organization focused on promoting the flexible, printed electronics industry.

• Our programs are designed to share practical experience and develop solutions for flexible and printed electronics, and related technologies, from R&D to commercialization.
The **FlexTech** Mission

- **Advocate for the FHE Industry**
  Build awareness within stakeholder communities about FHE and the impact of the technology on products and markets.

- **Champion R&D Funding**
  Work with DoD organizations to create advanced systems that leverage FHE strengths of lower weight, printable, lower power and large area electronics.

- **Connect & Educate**
  Coordinate conferences, workshops, webinars and other networking opportunities for industry and customers.
Our Network Includes the Leaders in FPE and FHE

We connect, educate and fund companies, universities and organizations throughout the supply chain.

*FlexTech has over 18,000 contacts in FHE and related industries

10/1/2015
Flexible, Printed Electronics

- Microelectronics changed the world by enabling many intelligent products
- A new field of electronics is emerging that cannot be made small, but must be big in order to interact with big things
- This is flexible, printed electronics and its most important feature is that it can conform to surfaces to impact a wide range of applications
# A Paradigm Shift in Electronics

## Conventional processing

<table>
<thead>
<tr>
<th>Subtractive batch processes (photolithography and wet/dry etching for layer definitions)</th>
<th>Additive continuous processes (printing, laser processing etc.) for layer definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controlled (e.g., a vacuum environment)</td>
<td>Ambient temperature and pressure conditions</td>
</tr>
</tbody>
</table>

| Fixed, long production runs of 'same product' | Flexible, short production runs - 'flexible' product functionality |

Source of images: Intel (conventional processing); PolyIC (additive processing)
Supply Chain Development
New Rules, New Manufacturing, New Jobs

- **Electronics Industry Helps Drive U.S. Economy**
  - Moore’s Law in silicon electronics drives to smaller features, higher density and complexity
  - Large multibillion $ manufacturing facilities – but many overseas

- **Future Electronics Opportunity**
  - Flexible (and potentially printed) electronics enables human scale products
    - *Wearable health monitors – Health Care & Battlefield Impact*
    - *Conformable and portable PV – Energy Impact*
    - *Flexible displays & e-books - Education, Training and Communications Impact*
  - New, distributed manufacturing
    - Printing electronics – customized diversified products manufactured closer to the end user – analogous of move from print shop to the home office – more accessible to large and small manufacturers
Flex Electronics Could Follow Similar Growth Path of ICs and FPDs

$1 \rightarrow $50B <10 years

© OE-A 2009

Source: SEMI, WSTS, DisplaySearch, NanoMarkets
Electronics Revolution (Again!)
A New Era of Electronics

Flexible Electronics

Health Monitoring

The Internet of Things

Personal Devices
Smart Packaging Enhances the Customer’s Experience

**Promotes**
- Entertain
- Lights
- Sounds
- Interactive
- Multiple Touch Points

**Communicates**
- Connection
  - Wired or Wireless
- Interactive
- Updates
- Ease of Use
- Programs

**Informs**
- Prompts
- Resets
- Reminds
- Recommends
- Helpful
- Motivates

**Secures**
- Theft Deterrence
- Tamper Evident
- Screamer Tag
- RFID:
  - Attached to smart package
  - Anti-counterfeit

© MeadWestvaco Corporation
Thin Film Sensor
FlexTech’s View of Market Opportunities

An entirely new industry will impact many sectors from consumer to defense and security.

Power
- Batteries
- Photovoltaic

Sensors
- Defense
- Health & Medical
- Infrastructure

Communications
- Displays
- Signage
Best Guess – 1st To Market

• Medical/Pharma suppliers
  – 1st responder, military, telemedicine/home health care, product integrity and security

• Sporting goods companies

• Food packaging industry
  – Product tracking, ID and integrity/security
Lessons Learned:
- Adequate supply chain in place
- Integration of multiple flexible components possible
- Customer’s Issues: Placement of device, wireless protocols
In your opinion, will flexible and printed electronics become widely integrated into commercial products within...
If your company or organization is planning on purchasing flexible, printed electronics in the next 1-3 years, roughly what is the annual unit volume expected?

- <100K units: 26.2%
- 100K - 1M units: 42.9%
- 1M units - 10M units: 16.7%
- 10M units - 50M units: 11.9%
- >50M units: 2.4%
- N/A: 0.0%
Multiple Entry Points for FPE

Production by the Global Electronics and IT Industries

(¥100 million; % change year-on-year (YoY))

<table>
<thead>
<tr>
<th>Year</th>
<th>Category</th>
<th>2011 (Results)</th>
<th>2012 (Results)</th>
<th>2013 (Estimates)</th>
<th>2014 (Forecasts)</th>
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<tbody>
<tr>
<td></td>
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<td>2,034,434</td>
<td>2,069,973</td>
<td>2,484,223</td>
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<td>AV equipment</td>
<td>174,145</td>
<td>153,958</td>
<td>414,004</td>
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<td>Communications</td>
<td>297,879</td>
<td>326,251</td>
<td>482,795</td>
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<td>Computers &amp; information terminals</td>
<td>394,060</td>
<td>410,836</td>
<td>118,033</td>
<td>124,423</td>
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<td>Other electronic equipment</td>
<td>103,161</td>
<td>103,239</td>
<td>197,692</td>
<td>206,895</td>
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<td>Electronic components</td>
<td>174,521</td>
<td>169,261</td>
<td>139,250</td>
<td>153,366</td>
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<td></td>
<td>Display devices</td>
<td>100,900</td>
<td>113,530</td>
<td>293,962</td>
<td>305,871</td>
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<td>Semiconductors</td>
<td>238,718</td>
<td>232,375</td>
<td>670,373</td>
<td>698,818</td>
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<td>IT solution services</td>
<td>551,050</td>
<td>560,523</td>
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</tbody>
</table>

10/1/2015
Current FlexTech Projects

We fund high payoff eco-system and demonstration projects
Upcoming Events

FuturePRINT@ GraphExpo
Sept 13-16, 2015
Chicago, IL

Novel and Innovative Power Systems Workshop
Sept 29 & 30, 2015
Binghamton, NY
The Annual FLEX Conference is the Leader in FHE Technical Content and Networking

2016

FLEX

Building the Innovation EcoSystem for Flexible Electronics

February 29 - March 3, 2016
Monterey, CA
Summary

Why Flexible Electronics?

- **Form and Fit**
  - Conformable substrates open up enormous application spaces
    - Textiles, buildings, paper, people

- **Cost**
  - Traditional IC lithography and vacuum processing are costly
    - Mix and match → printing → R2R provides significant savings if the target is “good enough”

- **Ecology**
  - Additive processes vs. removal

Why Now?

- Electronics industry always searching for new technology for markets
- Start-up capital available
  - e.g., Polyera, Imprint energy
- Early adopters available
  - Military, Wal-Mart
- High volume consumers seeking ideas → solutions
  - Dole, P&G, SmithKline Glaxo
- Early results promising