Flexible Applications Based on Printed Electronics Technologies
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What’s New in this Report Update?

• Up-to-date market forecast 2013-2020 in US$M and processed surface for printed, flexible & printed & flexible applications:
  – Displays
  – Lighting
  – Photovoltaic
  – Sensors, smart systems
  – Substrates

• Manufacturing processes analysis
  – Current challenges (technical & economical)
  – Roadmap
  – Manufacturing trends

• New players

• Update on new approaches: polytronics
Key Objectives of the Report

• This 2013 report is an update of the 2011 “Printed Electronics Reality vs. Hype” report

• The objectives of the report are:
  – To give forecast in processed surface and $M value for flexible printed electronics functions: Displays, Lighting, Energy Conversion (PV), Sensors & Substrates.
  – To present market and technical challenges associated with Flexible Printed Electronics: at the material & equipment levels.
  – To present examples of processes.
  – To give insight on new approaches (e.g. polytronics)

• This report does not cover:
  – Printed batteries
  – Printed super capacitors
  – Printed wires (Although these may be printed, they are electrical and not electronic)
  – Semiconductors (CMOS silicon)
  – Thin Film Photovoltaics or OLED displays using vacuum processing (CIGS, DSSC)
Coverage

What is and is not Included

• Printed electronics is often abbreviated “pe” and used as a prefix to denote each major application or technology

• It is important to note that there exists some confusion in this topic as many things may be “printed” or use “organics” or be “flexible”. Additionally, there are many printed, flexible and organic devices that are electrical and not electronic.

• In this report, we do NOT distinguish organic / non-organic substrates in our forecast.

• This report covers only “electronic” types of applications and technologies involving some kind of electron-hole semiconductor effect.
  – Manufacturing must include a type of printing technology in the product construction
  – Materials may be organic or inorganic or both in nature and on flexible substrates
  – We exclude any kid of vacuum or vapor deposition processing technology. These are not generally considered “printing” methods and if included it would include virtually the entire semiconductor and thin-film photovoltaics on glass….
Functions vs. Flexibility DoF: techno push vs. Market pull applications

- Some applications are likely to happen while some others are more technological-push (e.g. what will be the lifetime of a bendable screens, the washing resistance of a smart clothes integrating electronics?).
- Table below shows the ranking of the different applications:

<table>
<thead>
<tr>
<th>FUNCTIONS</th>
<th>CONFORMABLE</th>
<th>BENDABLE</th>
<th>&quot;UNUSED&quot; FLEXIBILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>SENSING</td>
<td>Touch Screens</td>
<td>Smart clothes</td>
<td>Sensors (gas, image)</td>
</tr>
<tr>
<td>DISPLAYING</td>
<td>Smartphones/tablets screens</td>
<td>e-readers, smart clothes</td>
<td>e-readers</td>
</tr>
<tr>
<td>LIGHTING</td>
<td>Automotive / Luxury OLEDs lighting</td>
<td>?</td>
<td>General OLED lighting</td>
</tr>
<tr>
<td>ENERGY GENERATION</td>
<td>Organic PV</td>
<td>Organic PV</td>
<td>Organic PV</td>
</tr>
<tr>
<td>SUBTRATES</td>
<td>Smart IDs, thin film batteries</td>
<td>Smart clothes</td>
<td>Smart IDs, thin film batteries</td>
</tr>
</tbody>
</table>
In the next years, the number of applications using printing processes for Flexible Electronics will grow.
Market forecast

2013-2020 Flexible & Printed Electronics Market

- Printed & Flexible Electronics is expected to be close to $1B market by 2020 with a 27% CAGR over 2013-2012

Flexible & Printed Applications Market for the Different Functions (in processed surface)

- In surface, displays and lighting will be more than 80% of total processed surface.

Market Breakdown 2013-2020 for Printed, Flexible & Printed/Flexible Applications

- Today, there are very few print&flex applications – however, by 2020, we estimate that about 33% of the total market will be for Print&Flex applications.
- We do not see a big market growth for « pure » bendable applications. However, in 2020+, there will be applications for conformable applications (such as automotive dashboard for example).
Detailed processes analysis

Small OLED displays: what is to be flexible? Printed?

Crystalline silicon PV (1): What is to be flexible? Printed?

OLED Lighting: what is to be flexible?

Crystalline silicon is a relatively mature PV technology, hard to develop more flexibility.

Encapsulation is the limiting factor for flexible OLED lighting.
Who should be interested in this report?

• **Systems makers**
  – Understand the potentialities of the printed electronics market
  – Understand the technical challenges

• **Devices makers**
  – Identify and evaluate printed electronics markets with market size & growth
  – Analyze the threads and opportunities
  – Monitor and benchmark your competitor’s advancements

• **Chemical & tools companies**
  – Identify what the technical hurdles for printed electronics are
  – Analyze the threads and opportunities

• **Financial & Strategic investors**
  – Understand the main market dynamics and main technological trends
  – Get the list of the key players
Companies cited in this Report

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