FLEXIBLE ULTRA THIN TOUCH FILMS AND SENSORS

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Flat is boring

Touch screen technology is spreading everywhere. So far touch has been possible on flat surfaces only.

Now, touch is needed on flexible shapes!
- Curved and foldable mobile phones
- Smart watches with touch on flexible bands and displays

And on 3D shapes!
- Touch on curved car dashboards and center consoles
- Steam and dust-proof UI panels for household machines – no buttons needed
- Curved mobile phone edges, sides and backside

New innovations for cool free form factors
Flexible Products Finally Coming of Age

Physical requirements for touch in flexible displays

- **Touch sensor must be thin** – Why?
  - Enables overall **thin form factor** for end device: more desirable for consumers
  - Enables **low weight**
  - Enables **flexibility**: thin substrates and films are more flexible than thick ones
  - Enables **design freedom** for display stack: allows most options for Neutral axis

- **Touch sensor should be integrated** – Why?
  - To reduce **cost** and **thickness**: fewer number of layers
  - To improve **flexibility**: fewer laminations – OCA lamination is difficult to control for flexibility

Source: IHS, 2016

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3442988/

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How much flexibility is required

• Most demanding near-term application for flexible touch displays: **Foldable tablets and smartphones**

- Flexible touch display stack must tolerate 2 mm bending radius: Individual layers must withstand at least 1 mm bending radius
- Repetitions: Lifetime is more than **150 000 bending cycles**

Source: IHS, 2016
Flexible material for touch: Carbon NanoBud® (CNB™)

- Hybridization of Carbon Nanotubes (CNTs) and Fullerenes (C_{60})
- Carbon NanoBud® material enables conductive CNB™ films
  - Highly transparent
  - Non-reflective
  - Flexible & Stretchable
  - Robust

NanoBud® Molecule
NanoBud® Network
NanoBud® Film
How to make CNB: Direct Dry Printing® manufacturing process

Roll-to-Roll aerosol printing of Carbon NanoBud material directly on substrate

- Combination of high purity material synthesis and aerosol printing
- High Quality (pure, dispersed, ready to use)
- High Volume (R2R)
- Green (no wet / toxic chemistry)
CNB Films are flexible

Less than 1% resistivity change at 1 mm bending radius over 150 k bending cycles.

→ CNB survives a lifetime of a foldable device
CNB One-Plastic-Solution for flexible touch displays

- Integrating touch sensor on the front window
- Extremely thin devices
- Total thinness: window + sensor 40 µm
- Designed for extreme bending and folding
- For wearable devices, foldable devices

**Conventional out-cell touch**

- Hard coat/AG/AR Film
- Cover window
- Decoration film
- OCA
- Touch sensor
- OCA
- Polarizer
- Adhesive
- Encapsulation Film/Layer
- AMOLED display
- Reflection Film

**On-cell touch with CNB OPS**

- Hard coat/AG/AR
- Cover window
- Decorations
- CNB Touch sensor
- OCA
- Polarizer
- Adhesive
- Encapsulation Film/Layer
- AMOLED display
- Reflection Film

**CNB OPS:**
Total Window+sensor: 40 µm
First CNB One-Plastic-Solution product

- **Polyera** Flexible Touch Display
- **Polyera** Wove Band
- **Canatu** CNB OPS touch sensor
  - Capacitive
  - Multi-touch

**Polyera Wove Band Boasts Flexible Display**

Polyera, a largely unknown startup, is making a splash with its Wove Band, a wearable device with a flexible display that can be wrapped around a user's wrist.
CNB OPS features various integration options

- Surface coatings, decorations, thicknesses, sizes, sensor patterns

<table>
<thead>
<tr>
<th>OPS features</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface coatings</td>
<td>Anti-Glare Hard Coat</td>
</tr>
<tr>
<td>Anti-Reflective Hard Coat</td>
<td></td>
</tr>
<tr>
<td>Deco color</td>
<td>Black</td>
</tr>
<tr>
<td>White and other colors</td>
<td></td>
</tr>
<tr>
<td>Thickness</td>
<td>40 um</td>
</tr>
<tr>
<td>30-65 um</td>
<td></td>
</tr>
<tr>
<td>Diagonal size</td>
<td>6&quot;, wrist device form</td>
</tr>
<tr>
<td>1&quot;-10&quot;, different aspects</td>
<td></td>
</tr>
<tr>
<td>Bendability</td>
<td>5 mm radius</td>
</tr>
<tr>
<td>Foldability, down to 1 mm radius</td>
<td></td>
</tr>
<tr>
<td>Further integration</td>
<td>Moisture barrier, UV blocker, polarizer</td>
</tr>
<tr>
<td>Reliability</td>
<td>See specifications</td>
</tr>
</tbody>
</table>

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CNB touch integration on Moisture Barrier

- Integrating touch sensor on the display Moisture Barrier film
- Extremely thin devices
- Total thinness: MB + sensor down to 17 µm
- Designed for flexible devices such as wearables
- For EPD (E-Ink) and AMOLED touch displays
- Further integration possible to a) Window (OPS), and/or b) Display top substrate

<table>
<thead>
<tr>
<th>Layer</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
<td></td>
</tr>
<tr>
<td>HC/AR/AG</td>
<td>3 um</td>
</tr>
<tr>
<td>Window film</td>
<td>23-50 um</td>
</tr>
<tr>
<td>OCA</td>
<td>15-50 um</td>
</tr>
<tr>
<td>MB Film</td>
<td>12-50 um</td>
</tr>
<tr>
<td>CNB Touch layer</td>
<td>0.05 um</td>
</tr>
<tr>
<td>Ag traces</td>
<td>5 um</td>
</tr>
<tr>
<td>OCA</td>
<td>15-50 um</td>
</tr>
<tr>
<td>Display</td>
<td></td>
</tr>
</tbody>
</table>

Total On-cell touch thickness (MB+sensor): 17-55 µm
First product with CNB Moisture Barrier Integration

Flexible device with reflective EPD display

- Production starts in June 2016
- Capacitive 2-finger touch
- CNB sensor on 12 µm Moisture Barrier film

CANATU SECURES A FLEXIBLE ON-CELL TOUCH PROJECT WITH MOISTURE BARRIER INTEGRATION

HELSENNI, FINLAND, January 28, 2016 /EINPresswire.com/ -- Canatu, the leading manufacturer of next-generation flexible and 3D formable transparent conductive films and touch sensors, has secured its latest design win from an innovative customer in North America.

Canatu continues to expand its leverage and expertise in flexible touch displays with its latest on-cell design involving touch integration onto moisture barrier film. Following a lengthy development process with the innovative customer, Canatu has secured a design win for a significant high volume order. Further information will be revealed after the launch of the product in spring 2016.

In response to the exacting design brief requiring flexibility, thinness with zero haze and reflections, Canatu designed a bespoke on-cell touch solution. The on-cell solution is a more refined version of Canatu's previously announced One-Plastic Solution (OPS), taking the process one step further by integrating the reflective display moisture barrier film with the touch sensor.

“Canatu’s offerings, including its OPS, are all based on the proprietary, flexible Carbon NanoBud® material. The zero haze, zero reflectance properties of CNB material provide for excellent optical performance and unparalleled outdoor readability. This latest design win underscores the unmatched capabilities of our CNB-based films. Combining flexibility with superb optical performance, CNB films enable designs that cannot be realized with alternative metal based transparent conductive materials on the market today. Our moisture barrier integrated touch solution can soon be utilized for any moisture sensitive flexible displays such as reflective E Ink or emissive AMOLED”, says Erkki Soininen, VP Marketing and Sales for Canatu.

“Our moisture barrier integrated touch solution can soon be utilized for any moisture sensitive flexible displays such as reflective E Ink or emissive AMOLED” — Erkki Soininen, VP
CNB Touch Integration Roadmap for AMOLED

- **Out-cell**
  - Cover Glass/Plastic
  - OCA
  - Touch sensor
  - Polarizer
  - Adhesive
  - Encapsulation Glass/Film
  - AMOLED TFT
  - Reflection Film

- **Touch on cover**
  - Touch on Cover Glass/Plastic
  - OCA
  - Polarizer
  - Adhesive
  - Encapsulation Glass/Film
  - AMOLED TFT
  - Reflection Film

- **On-cell on polarizer**
  - Cover Glass/Plastic
  - OCA
  - Touch on Polarizer
  - Adhesive
  - Encapsulation Glass/Film
  - AMOLED TFT
  - Reflection Film

- **Hybrid In/Out-cell**
  - Cover Glass/Plastic
  - OCA
  - Touch on Polarizer
  - Adhesive
  - Touch on encapsulation Glass/Film
  - AMOLED TFT
  - Reflection Film

- **Hybrid Out/on-cell**
  - Touch on Cover Glass/Plastic
  - OCA
  - Touch on Polarizer
  - Adhesive
  - Encapsulation Glass/Film
  - AMOLED TFT
  - Reflection Film

**Timeline:**
- 2015
- 2016
- 2017
- 2018
Canatu in brief

• Canatu makes **flexible transparent conductive CNB™ (Carbon NanoBud®) Films and sensors** for
  – Flat
  – Flexible
  – Formable
  – Touch modules
  – Touch displays
  – Touch sensitive surfaces

• **Over ten years of know-how** of the Carbon NanoBud® material technology

• **Roll-to-roll line** ramped up now

• **In production** now
  – 3 design wins for flexible devices since 6/2015
  – Shipments for first automotive customer started in 7/2015

• **Strong customer pipeline**: 30+ prototyping projects on-going

**Markets**

• mobile phones & tablets
• e-readers
• wearable devices
• automotive
• industrial and healthcare
• home appliances
CNB sensor supply partner network

Display partners:
- Eink
- PLASTIC LOGIC
- Polyera
- VIA optronics

Touch controller partners:
- Atmel
- Synaptics
- CYPRESS
- FocalTech
- Raydium

Touch module partners:
- Canatu HQ and factory
- Canatu Sales Office
- Sensor/Display partner
Enabling flexible touch displays - Summary

- Flexible display market is exploding
- Market needs thin and integrated touch
- CNB Films available at 23 um, foldable to <1 mm over product lifecycle
- CNB touchintegrations available in products now
  - One-Plastic-Solution – touch on flexible window
  - Touch on Moisture Barrier

http://informationdisplay.org/IDArchive/2015/JanuaryFebruary/FrontlineTechnologyOrganicTFTS.aspx
Winner of
SID Display Component of the Year Silver Award

Canatu’s CNB™ (Carbon NanoBud®) Film
Thank you!

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