Flexible Glass: Advantages for Today, Advancements for Tomorrow

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Division Vice President and Corning® Willow™ Glass Program Director
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Topics

• What is Corning® Willow™ Glass?
• Advantages of Willow Glass over other substrate materials
• Applications that will benefit from Willow Glass
What is Corning® Willow™ Glass?

ADVANTAGES

Over Thicker Glass
- Flexible/conformable
- 7x reduction in weight
- 7x reduction in thickness
- ~50% process cost reduction by enabling roll to roll processing

Over Plastic
- Perfect barrier
- ~7% better transparency
- High T processing – over 500°C

Ultra-slim flexible glass is a 50-200µm thick glass

1m wide, ≥300m long spool and Gen5 sheet of thin flexible glass
Thin and light = Increased value

Mobile

Slate / NB

Monitor

TV

E-reader

Form Factor

- Thin and Durable
- Thin, Light and Durable
- Thin
- Thin
- Thin, Light and Durable

Seamless
Seamless
Seamless
Seamless
Seamless

Slim bezel
Slim bezel
Slim bezel
Slim bezel
Slim bezel

Panel Performance

- Power
- Resolution
- Durability
- Power
- Color shift (slate)
- Durability
- Power
- Resolution
- Motion blur
- Durability
- Power
- Reflectivity
- Rewriting speed
- Color

New Features

- Touch
- 3D?
- Touch (slate)
- 3D?
- 3D
- IPTV
- 3D
- Touch
What drives need for flexible display substrates?

- Conformable before flexible – value added application for conformable displays exist
- Ahead of the cost curve through R2R processing – flexibility of plastic processing with superior quality of glass substrates

**Flat**

**Curved**

**Bendable**

**Rollable**

**Thin and Light and Tough**

**Stylish?**

**Foldable**

**A Different World?**
Cost-efficient, high performance displays – Flexible glass addresses the challenge

**Customer Need**
- Alternative materials

**Flexible Glass Advantages**
- High device performance
- Efficient processing
- Enables new markets and technologies

**Corning Delivers**
- Glass attributes in a thin, flexible format
- Highly efficient manufacturing ecosystem
- Added functions – flexibility, durability, active thin films, etc.

The future is flexible.
Corning® Willow™ Glass will help revolutionize electronics processing

Delivers LCD-grade substrate quality
Compatible with high reliability devices

45 gram ball dropping on 0.1 mm flexible glass laminated to 1 mm Corning® Gorilla® Glass
What is Corning® Willow™ Glass?

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Flexible glass enables device performance

**Surface Roughness**

- Glass
- PEN
- Polyimide

**Dimensional Stability and High T capable**

**Optical Transmission**

- 330mm film sensor
- 150mm Glass sensor

**Oxygen/water barrier**
Applications for Corning® Willow™ Glass demonstrated at SID Display Week 2012 – Booth 123

• Touch
  – 3x thinner than high-performance film sensor
  – 2% points higher transmission
  – 5X lower haze
  – 2.5X lower b value

• Color Filter
  – 5x thinner than rigid glass color filter
  – No additional thinning needed
  – Delivers same resolution and brightness
  – Compatible with on-cell touch
# Flexible glass applications roadmap

<table>
<thead>
<tr>
<th>Lab-scale device demos</th>
<th>Initial commercial products</th>
<th>Next-generation technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP Oxide TFTs</td>
<td>OLED or LCD Color Filter</td>
<td>Flexible display</td>
</tr>
<tr>
<td>WMU / CAMM Organic PV</td>
<td>ProCap Touch Sensor</td>
<td>E-Paper</td>
</tr>
<tr>
<td>ITRI-DTC Ch-LC display</td>
<td>Flexible CIGS PV panels</td>
<td>OLED lighting</td>
</tr>
<tr>
<td>University of Stuttgart TFT-LCD</td>
<td></td>
<td>Organic PV</td>
</tr>
</tbody>
</table>

- **2010**
  - ITRI-DTC Ch-LC display
- **2011**
  - WMU / CAMM Organic PV
- **2012**
  - University of Stuttgart TFT-LCD
  - Flexible CIGS PV panels
- **2013**
  - ProCap Touch Sensor
- **2014**
  - OLED or LCD Color Filter
  - Flexible display
- **2015**
  - Roll-to-roll displays
Flexible Glass Ecosystem Development Plan

- Corning
- OEM/ODM
- Customers
- Equipment Vendors
- Research partners
- Corning Internal

Fusion Process

Handling, device cutting, lamination, packaging
## Flexible glass availability

<table>
<thead>
<tr>
<th></th>
<th>Now</th>
<th>Q4 2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sheets</strong></td>
<td>250mm x 300mm</td>
<td>Gen 5 1000mm x 1200mm</td>
<td>&gt;Gen 5 1000mm x 1200mm</td>
</tr>
<tr>
<td><strong>Rolls</strong></td>
<td>10m long x 300mm wide</td>
<td>~300m long x Up to 1m wide</td>
<td>~300m long x Up to 1m wide</td>
</tr>
<tr>
<td><strong>Quantity</strong></td>
<td>Development quantities</td>
<td>Engineering quantities</td>
<td>Pilot production</td>
</tr>
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Note: Dimensions reflect maximum available sizes
Corning® Willow™ Glass: Superior attributes delivering superior displays and efficient processes

**High-Performance Glass Substrate**
- High T processing
- Excellent optical quality
- Unmatched barrier properties
- Compatible with sheet-based or roll-to-roll processing

**Superior Displays**
- Thin
- Light
- Curved
- Flexible
- Cost-efficient
The last word…

- The future is flexible
- The future is here
- Glass Matters…Glass Works…Corning glass works
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