Architecture and BIPV: innovative materials enabling new design possibilities

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Healthcare, Life Science & Performance Materials

founded in 1668

66 countries

39,000 employees

€1.7 billion invested in R&D in 2014

€11.3 billion sales in 2014
Performance Materials
Facts & Figures

Sales by region 2014 in € million
- 74% Emerging Markets 1,524
- 7% North America 135
- 9% Europe 193
- 10% Rest of world incl. Japan 208

Highly competitive and international business
- Chemical Industry
  - Total Revenues: 2.06 billion Euro*
  - Number of Employees: 5,900
  - Number of Customers: around 5,000
  - Number of Products: more than 7,200
  - R&D Spending: almost 10%

* figures based on FY2014 annual results for Merck’s businesses as of March 3, 2015
“Performance“ segment
=> Solutions derived from excel sheets

As much energy as possible (=> revenues)
for the lowest investment (=> ROI)

Doesn‘t really matter how it looks…!
„Integration“ segment
=> solutions driven by function and aesthetics

As *functional* as possible (=> integration)
for the *highest added value* (=> multiple drivers)

Aesthetics are one main driver...!
The ideal solar cell and its value drivers

No “one fits all solution” due to several trade offs

Performance

- Efficiencies independent of light intensity & type
- Low costs & capex light production
- High efficiency & stability
- Efficient off-axis light collection
- Semi-transparency and grey-scales
- Ability for different colors
- Flexible and light-weight
- Thin - minimal material usage

Integration
# PV technologies – a status snapshot

<table>
<thead>
<tr>
<th>Performance</th>
<th>“$ per Watt”</th>
<th>Integration</th>
<th>“New Applications”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary efficiency</td>
<td></td>
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<tr>
<td>Lifetime</td>
<td></td>
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<td>Return on Investment</td>
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</tbody>
</table>

### Performance

<table>
<thead>
<tr>
<th>Existing</th>
<th>Entry</th>
<th>Next</th>
<th>Upside</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crystalline</td>
<td>Thin film&lt;sup&gt;1&lt;/sup&gt;</td>
<td>e.g. DSSC</td>
<td>e.g. OPV</td>
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</tbody>
</table>

### Integration

| Form factor (weight, thickness, flexibility, ruggedness) | | | |
| Appearance (colors, transparency) | | | |
| Secondary Efficiency (off angle & indoor) | | | |
| “Green” (energy payback, toxicity) | | | |

### Maturity

1) Depending on thin film technology (amorphous silicon, CdTe, CIGS)

*) Lead based version

Getting ready for market – Organic Photovoltaics (OPV)

EU funded ROTROT-project
Fully printed roll-to-toll OPV tandem cell
An important milestone on the road to green mass-production

EU funded ROTROT-project
BIPV - visualizing the importance of color

Colored windows in architecture (no PV function):

Merck’s portfolio of darker colors (example OPV):

Diener & Diener / Norvatis Campus / Basel, Suisse

Examples of colors feasible with Merck’s OPV solutions
SOLAR TREES WITH OPV TECHNOLOGY

Solar Trees @ Expo Milano
OPV as design element in membrane architecture
OPV trees power LED illumination at night
OPV laminated in glas – freedom of shape & design
PV (DSSC) as sun shading systems

**Passive system**
- Sun shading
- Design

**Active system**
- Sun shading
- Design
- Electricity generation

With courtesy from Colt international GmbH

Merck – modular innovation center - Darmstadt
From complying with traditional design rules…
...to futuristic design!
What we offer to you

Open to discuss and share your ideas and vision for the future
Capable to partner up creating synergies of our different strengths
Develop the market together and make it happen... faster ....
Thank you!