TRANSPARENT, SCRATCH-RESISTANT LAYERS ON LARGE AREA SUBSTRATES

Technology

▪ high-rate electron beam evaporation
▪ plasma-activation by hollow cathode arc discharge (HAD process)
▪ organic modification by combination with PECVD
▪ high deposition rates on large areas (50 ... 600 nm/s)
▪ high productivity – low cost
▪ low thermal load (plastic, e.g. PC, max. temperature < 130°C)
▪ wet chemical cleaning (metals prior vacuum processing)
▪ (pulse) plasma pre-treatment
▪ technology development to customized requirements
▪ pilot production for metal strips, plastic films (300 mm width) and large sheets (500 mm x 500 mm) in large scale pilot plant MAXI

Applications

▪ kitchen
▪ indoor interior
▪ architecture
▪ automotive
▪ rail-bound transportation
▪ lighting
▪ solar thermal absorber
▪ photovoltaic

Substrates

▪ materials:
  ▪ plastics (e.g. polycarbonate),
  ▪ metals (e.g. stainless steel),
  ▪ glasses (e.g. float glass),
  ▪ ceramics (e.g. tiles)
▪ shape:
  ▪ small, medium size and large area flat substrates (sheets, strips, films)
  ▪ simple shaped 3D substrates
Characteristics

Transparent, scratch-resistant layers on large area substrates from plastics, metals, glasses and ceramics.

The optical appearance of the surface will not be altered by coating.

Layers:
- silica based (SiOₓ) and alumina based (AlₓOᵧ) coatings
- thickness 1 … 10 µm
- organic modification by incorporation of carbon
- improved elasticity
- incorporation of nano-crystalline Si in the SiOₓ layer matrix for extremely high hardness

Mechanical properties:
- high hardness (2 … 15 GPa) compared to substrate (see table)
- high abrasion resistance (see graph, fig. 7)
- excellent adhesion, even in the presence of moisture (plastic substrates)
- low internal stress
- elastic and plastic deformability up to 3%
- stability against temperature cycling
- high corrosion resistance
- low finger print sensibility

Optical properties:
- high transparency (k: 0.001 … 0.01 @ 550 nm)
- high uniformity of layer thickness

<table>
<thead>
<tr>
<th>Substrate</th>
<th>Hardness of the substrate [GPa]</th>
<th>Hardness of the SiOₓ layers [GPa]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polycarbonate</td>
<td>0.11*</td>
<td>2 … 3</td>
</tr>
<tr>
<td>PET</td>
<td>0.15*</td>
<td>2 … 3</td>
</tr>
<tr>
<td>PMMA</td>
<td>0.18*</td>
<td>2 … 3</td>
</tr>
<tr>
<td>Ferritic steel (St 14)</td>
<td>ca. 1</td>
<td>8 … 15</td>
</tr>
<tr>
<td>High-alloy steel (X5 CrNi 18.10)</td>
<td>3 … 4</td>
<td>8 … 15</td>
</tr>
<tr>
<td>Float glass</td>
<td>ca. 6</td>
<td>8 … 10</td>
</tr>
</tbody>
</table>

Hardness measurement by nano-indentation; * Ball indentation

7 Transparent, hard (ca. 9 GPa) SiOₓ layers on glass substrates subjected to the Taber Abraser test. Parameters: Friction wheels CS-10F, 500 g load

4 Indoor interior
5 High abrasion resistance
6 Automotive

We focus on quality and the ISO 9001.