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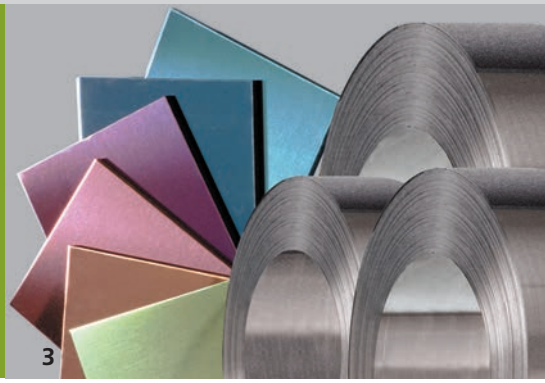
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1 *Lighting*
2 *Kitchen*
3 *Indoor interior*

TRANSPARENT, SCRATCH-RESISTANT LAYERS ON LARGE AREA SUBSTRATES

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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 × 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

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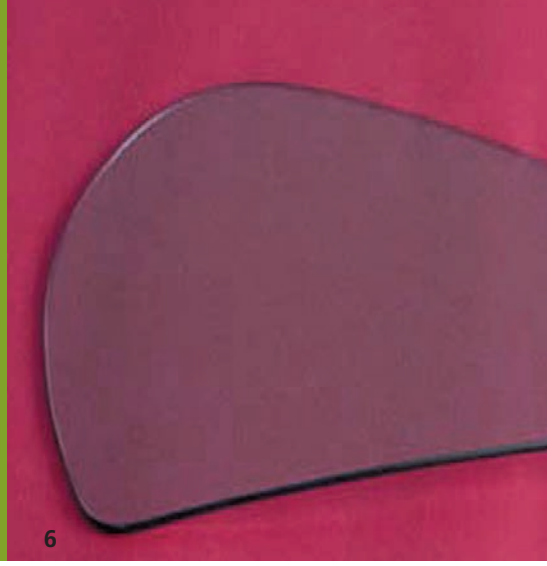

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Characteristics

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 (SiO_x) and alumina based (Al_2O_3) coatings
- thickness 1 … 10 µm
- organic modification by incorporation of carbon
- improved elasticity
- incorporation of nano-crystalline Si in the SiO_x 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:

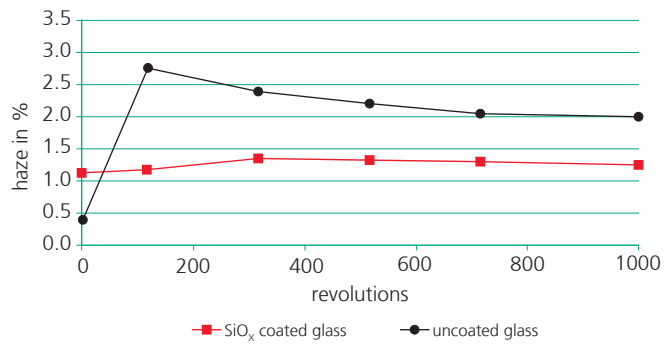
- high transparency (k: 0.001 … 0.01 @ 550 nm)
- high uniformity of layer thickness

Hardness of substrates and abrasion-resistant SiO_x layers

Substrate	Hardness of the substrate [GPa]	Hardness of the SiO_x layers [GPa]
Polycarbonate	0.11*	2 … 3
PET	0.15*	2 … 3
PMMA	0.18*	2 … 3
Ferritic steel (St 14)	ca. 1	8 … 15
High-alloy steel (X5 CrNi 18.10)	3 … 4	8 … 15
Float glass	ca. 6	8 … 10

*Hardness measurement by nano-indentation; * Ball indentation*

7 Transparent, hard (ca. 9 GPa) SiO_x 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*

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