

# Functionalized ultra-thin flexible glass

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**A new substrate for emerging applications**



1  
Ultrasonic inline wet cleaning line with optimized horizontal roller transport for glass thicknesses from 30 μm to 6 mm (clean room handling in the background)



2  
Thermo-chromic coating on 100 μm flexible glass, e.g. for use in window applications

## Emerging substrate

Ultra-thin flexible glass with thicknesses equal to or lower than 100 μm opens up opportunities for new applications, especially in the area of high-end electronics and optics. It paves the way for the development of thin, light, robust, curved and bendable devices. With a bendability similar to other web materials,

ultra-thin glass excels polymers in dimensional and thermal stability and chemical resistance. Thus, ultra-thin glass is a perfect light weight substrate for high quality functional layers and layer stacks.

## Applications

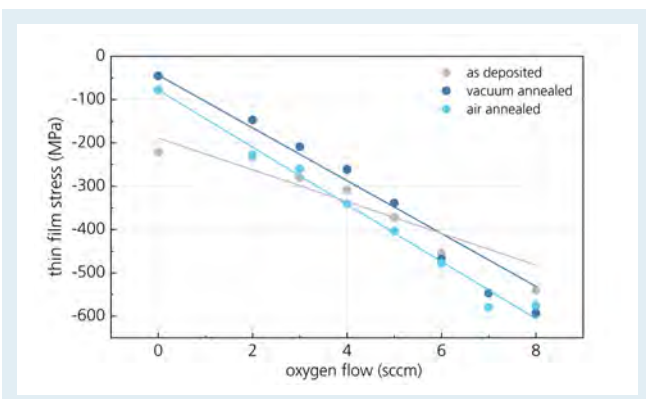
- Automotive interior/exterior design
- Displays
- Wearables
- Sensors
- High-tech optics

- Smart surfaces
- Smart windows
- Building integration
- Photovoltaics
- Energy storage systems

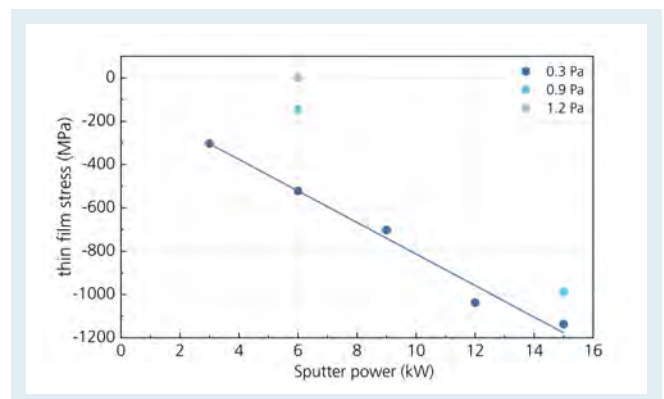
## Research focuses

Fraunhofer FEP develops technical solutions for flexible glass processing and conducts research on the impact of processing on the reliability of flexible glass. Another research focus is the adaptation of existing processes to the special needs of flexible glass. Moreover, Fraunhofer FEP is working on the efficient large area deposition of homogeneous coatings based on

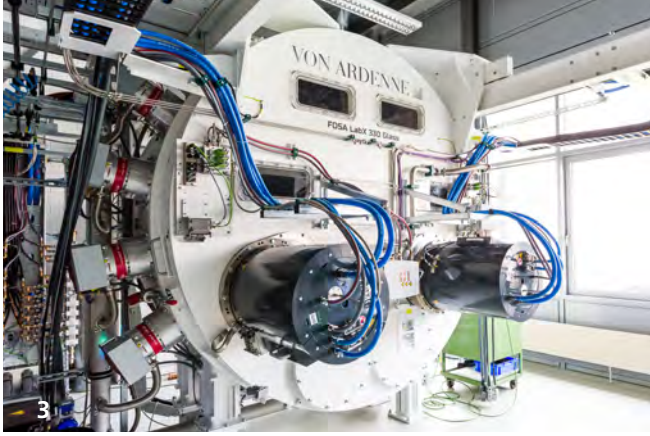
complex layer stacks, e.g. edge filters (Fig. 4). For example, the optimization of sputter parameters, leads to adjustable mechanical stress values while still retaining a reasonable physical density and refractive indices for environmentally stable, shift-free optical single or multilayer systems.



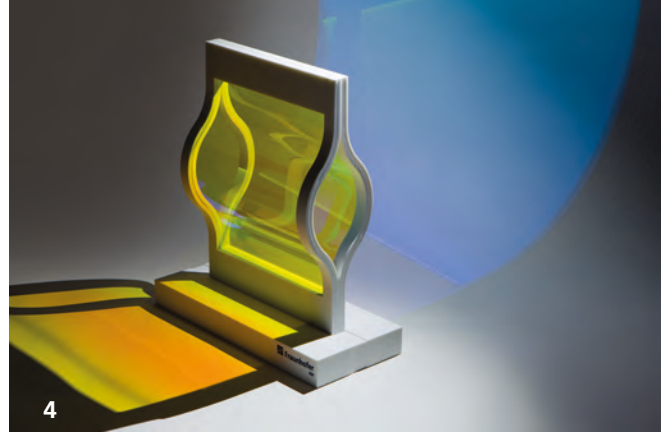
Thin film stress of ITO films deposited on 100 μm flexible glass at a pressure of 0.3 Pa depending on oxygen flow and post treatment



ZrO<sub>2</sub> thin films deposited on 100 μm flexible glass at a pressure of 0.3 Pa, refractive index  $n > 2.20$  @ 550 nm



FOSA Lab X 330 Glass for coatings on flexible glass in a roll-to-roll process






Edge filter on flexible glass, for e.g. laser applications (cut-off @ 560 nm)

## Our offer

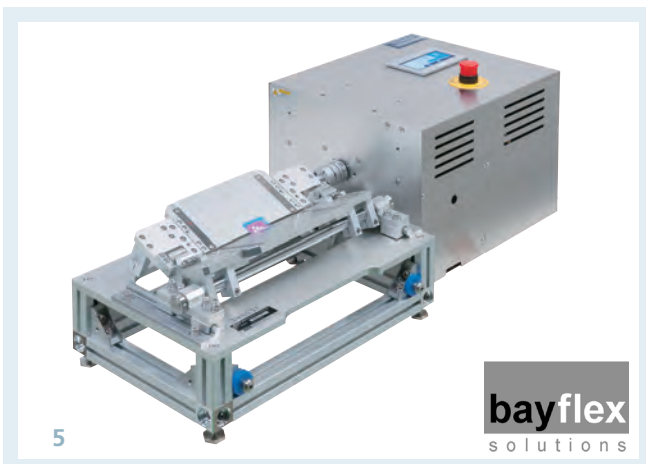
Fraunhofer FEP is specialized in flexible glass functionalization representative for industrial scale. We use an innovative process chain comprising an ultrasonic wet cleaning line and

professional inspection, handling and coating equipment, all under cleanroom conditions as well as the respective metrology. Our capabilities in thin-film deposition are outlined below:

**We offer coating and stack development as well as demonstration of scaling and feasibility studies on industrial-size equipment.**

	Equipment	Substrate size	Glass thickness	Film type
<b>Sheet-to-sheet</b> 	ILA 900: Vertical Inline vacuum coater	max. 600 × 1200 mm <sup>2</sup>	50 µm ... 6 mm	Inorganic thin-films
<b>Roll-to-roll</b> 	FOSA LabX: Laboratory roll coater RC300: Pilot roll coater	max. 300 mm width 20 – 30 m length*	50 µm ... 100 µm, optional on 75 µm polymer carrier web	Inorganic thin-films Organic thin-films
	LS01: Laboratory lamination and structuring unit	20 – 30 m length	50 µm ... 100 µm, optional on 75 µm polymer carrier web	Printed passivation, UV activated, epoxy based printing paste, lamination of glass-glass with pressure sensitive adhesive (PSA)

\* usual length for pilot scale, >50 m length possible, especially using 50 µm glass on 75 µm polymer carrier web



Tension free clamshell folding test

### Test equipment for strength and reliability testing

Fraunhofer FEP offers several testing facilities and extensive know-how regarding parameter fields for successful flexible glass functionalization. Besides the multitude of thin film characterization methods, suitable test machines are available for strength and fatigue testing of uncoated and coated glass.

# Contact

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