The Digitization of Optics Fabrication

Printoptical Technology

Rapid Manufacturing

Services for Custom Optics

Marco de Visser, LUXIMPRINT | Dec. 02, 2024

Micro-Optics Summit 2024 | Amsterdam

Thanks for joining this session – a pleasure to connect!

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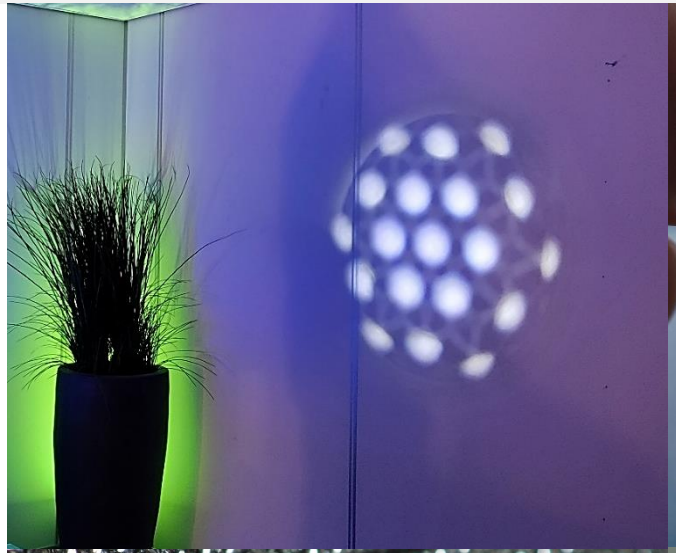
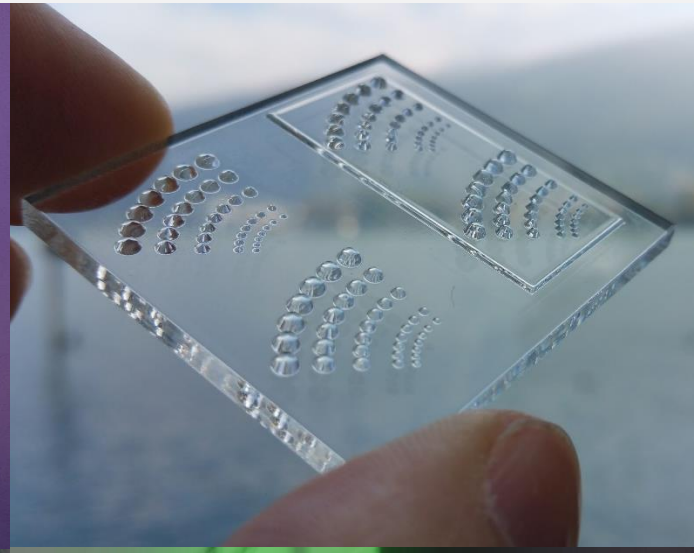
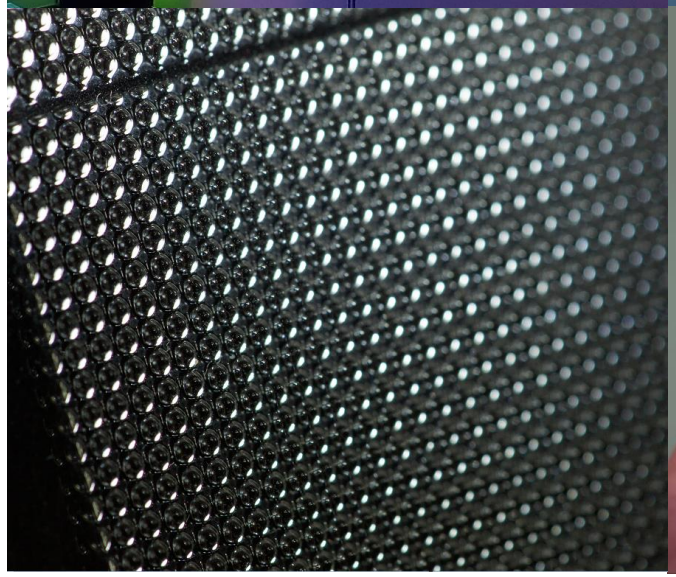
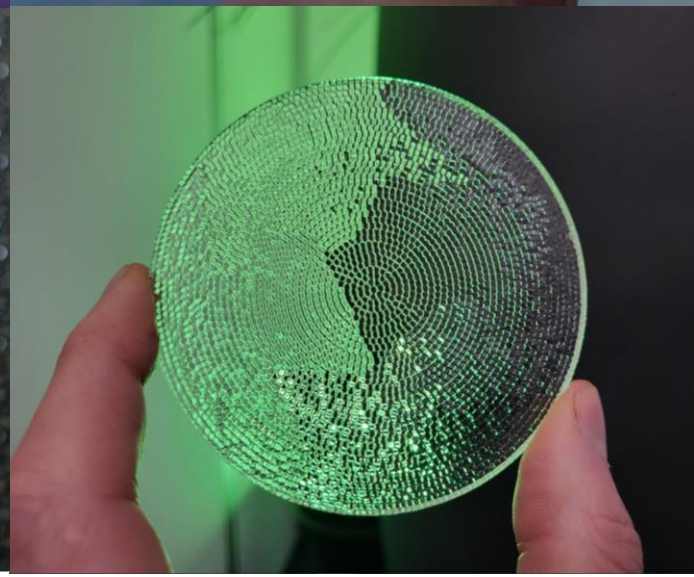
Presentation Content

- Company Introduction
- Mission & Business Model
- Printoptical Capabilities
  - Design Guidelines
  - Material Specifications
  - Surfaces & Finishes
- Products & Services
- Reference Cases

// COMPANY INTRODUCTION

ABOUT & MISSION STATEMENT

LUXIMPRINT

Company Introduction

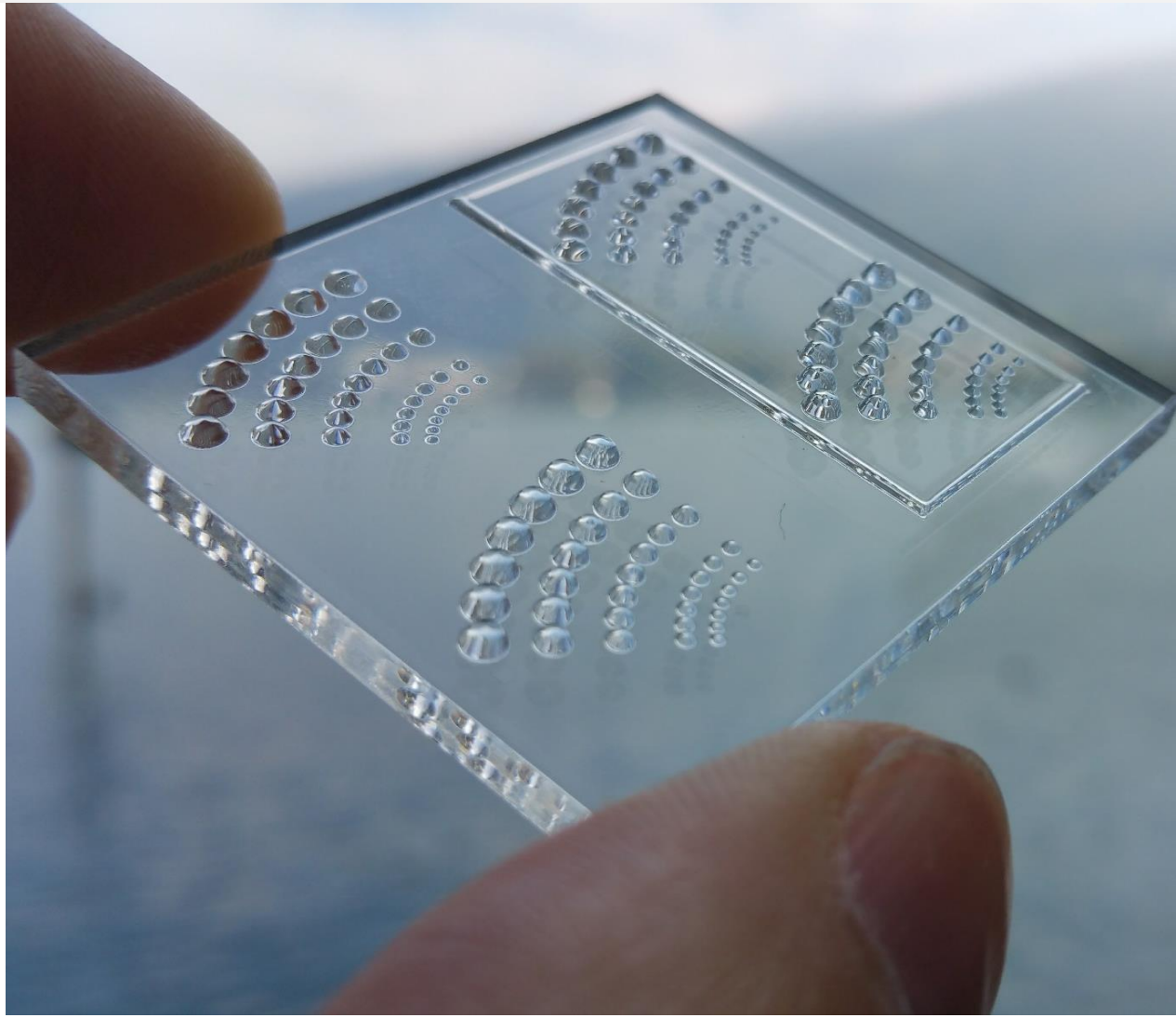
- Early spin-out Luxexcel Group (2017 > 2009)
- Use of proprietary ‘Optical 3D Printing Technology’ for Rapid Prototyping of Custom illumination optics;
- Direct ‘*CAD-to-Optic*’ approaches;
- Singlets, lens arrays and complex textures;
- Focus on ‘making’, design services facilitated;
- Manufacturing-as-a-Service (M-a-a-S);
- Headquarters based in Wemeldinge, Netherlands, with a global representation.

Our Mission and Drive

We want enable our users to:

- Reduce lead times (“time-to-market”)
- Speed up development processes
- Easy trial & error (iterative design processing)
- Delay or eliminate tooling investments
- Reduce stock levels (no MOQ)
- Customize their products
- Empower new product development

… explore the beauty of light!



Business Model | Manufacturing-as-a-Service (MaaS)

Luximprint offers 'Manufacturing as a Service' to Designers and Engineers of Novel Lighting Systems in multi-market applications utilizing its proprietary 'optical 3D printing' process for custom optics.

- **FAST**

  Prototyping of Custom Optics in days;

  Standard Services: 5-10 business days + shipping

  Expedite Services: < 5 business days + shipping

- **FLEXIBLE**

  Digital Fabrication Process

  Easy '*Duplicates*' and '*Design Variations*' (same job) and '*Design Iterations*' (next job)

- **COST-EFFECTIVE**

  No Tooling Cost, no Minimum Order Quantities required ("MOQ = 1 piece")

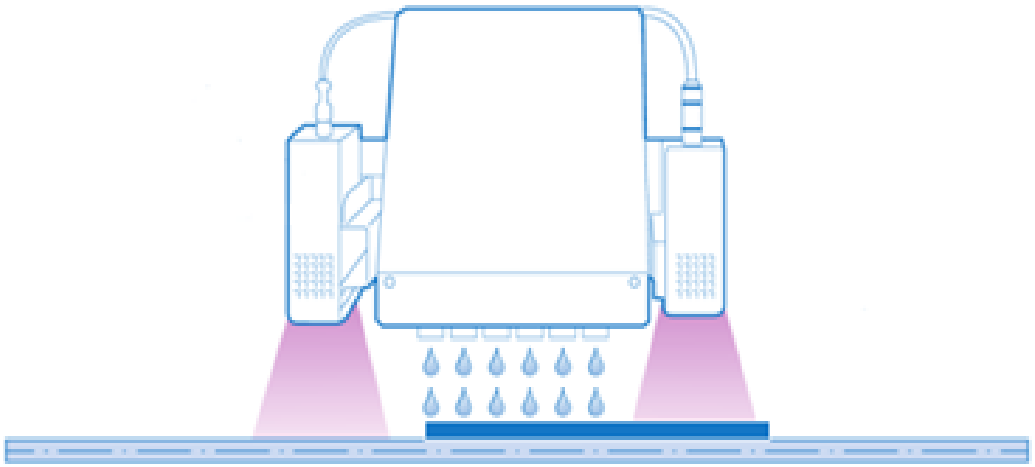
  Direct 'CAD-to-Optic' manufacture for 1 .. 10 .. 100's of parts (prototyping + pre-series)

// PROCESS & MATERIALS

PRINTOPTICAL CAPABILITIES

LUXIMPRINT

3D Printing Optics | How it Works

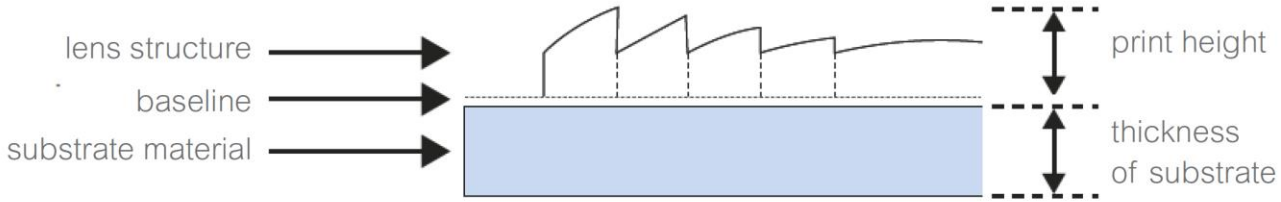


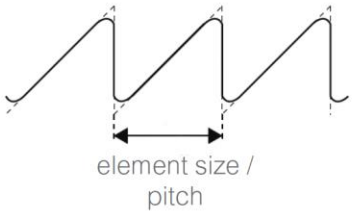
Inkjet print head deposits drops of liquid material onto a build plate, and then cure it into a solid by UV-light.

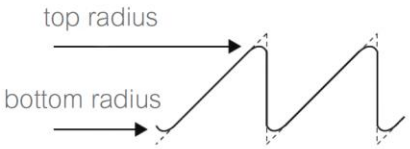
Surfaces are **optically smooth** (straight from the printer!) with zero need for post-processing, such as polishing or grinding.

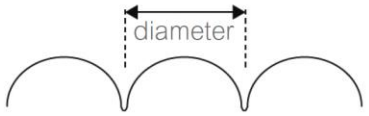
If applicable, frosted finishes (‘wanted roughness’) can be applied on demand in one and the same process.

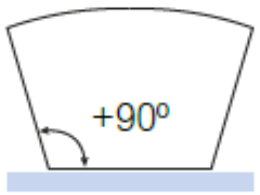
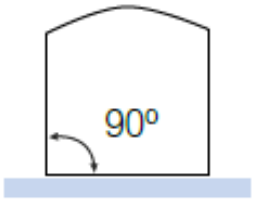
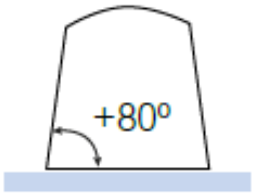
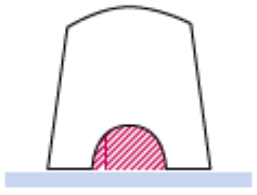
Printoptical Capabilities | Design Guidelines (1)









			
no overhangs or undercuts	**vertical walls**	**vertical walls**	**no hollows**
X	X	√	X

Structure Print height	: 0.3 – 5 mm*
Thickness Substrate	: 0.5 – 10 mm*
Substrate materials:	: PMMA / PC / PET-G
	: Other materials: t.b.d.

Top radius	: 80-120 microns*
Bottom radius	: 100-200 microns*
Element size / pitch	: 1.0 mm*
Diameter	: 1.0 mm (single lens)*

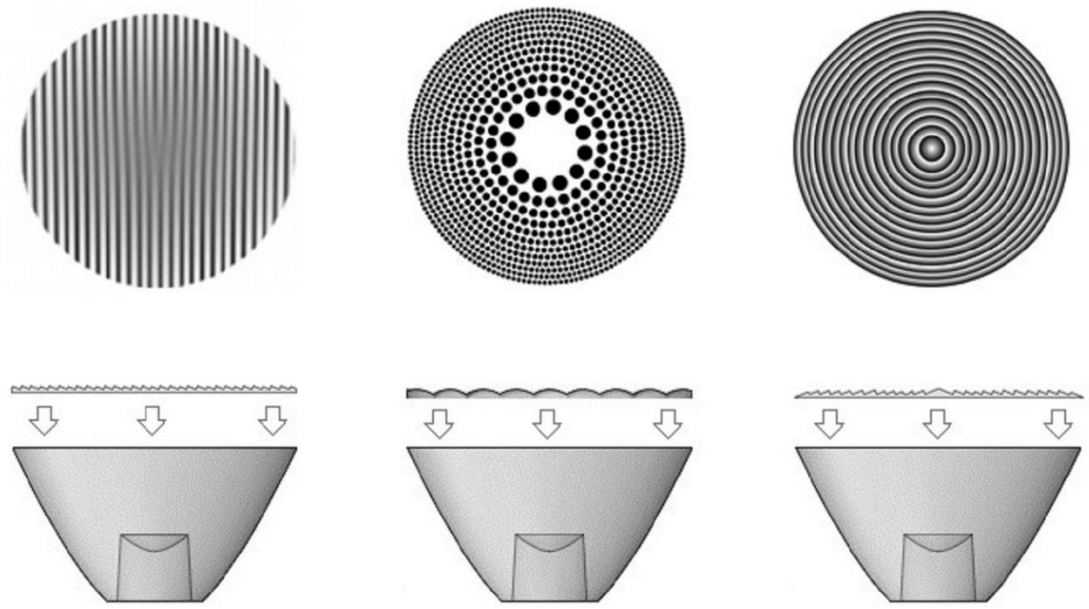
DESIGN RULES

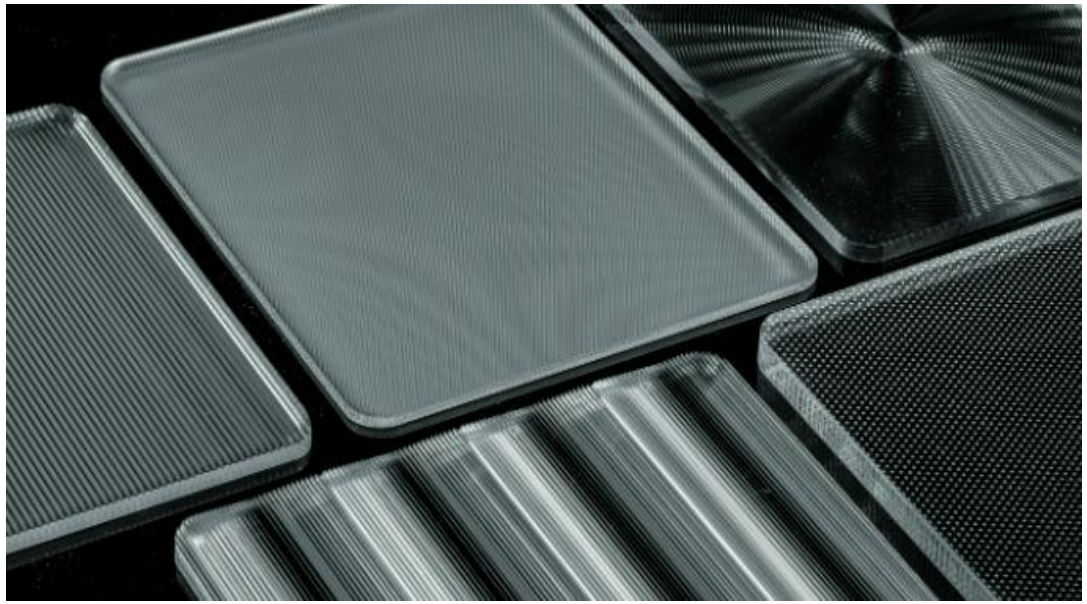
- No hollow sections!
- No overhangs/undercuts
- Single sided printing (bonding of parts possible)
- Dual side printing possible, see next slide
- Post-processing with (conventional) optics mfg. technologies possible.

Printoptical Capabilities | Design Guidelines (3)

Printing on Existing (Optics) Sheets and Lenses

Reworking existing sheets and lenses – either for optical correction or novel development – is well possible after loading them into the Luximprint Platform. Additions can either incorporate functional lens structures or frosted finishes.



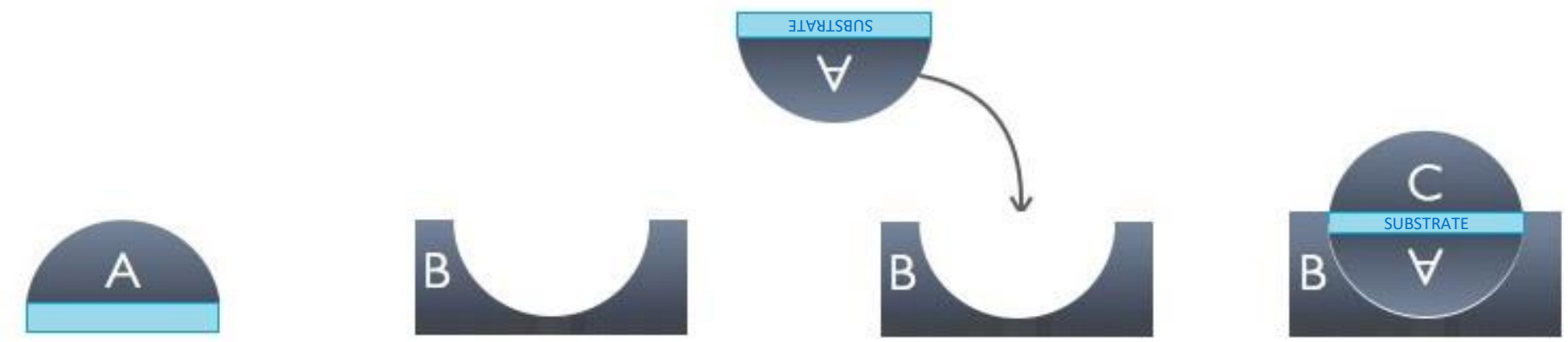


Printoptical Capabilities | Design Guidelines (2)

Dual-sided Printing Approach

Printing on two sides of the substrate is possible, leading to different solutions and enhanced capabilities.*

Here is how it works:



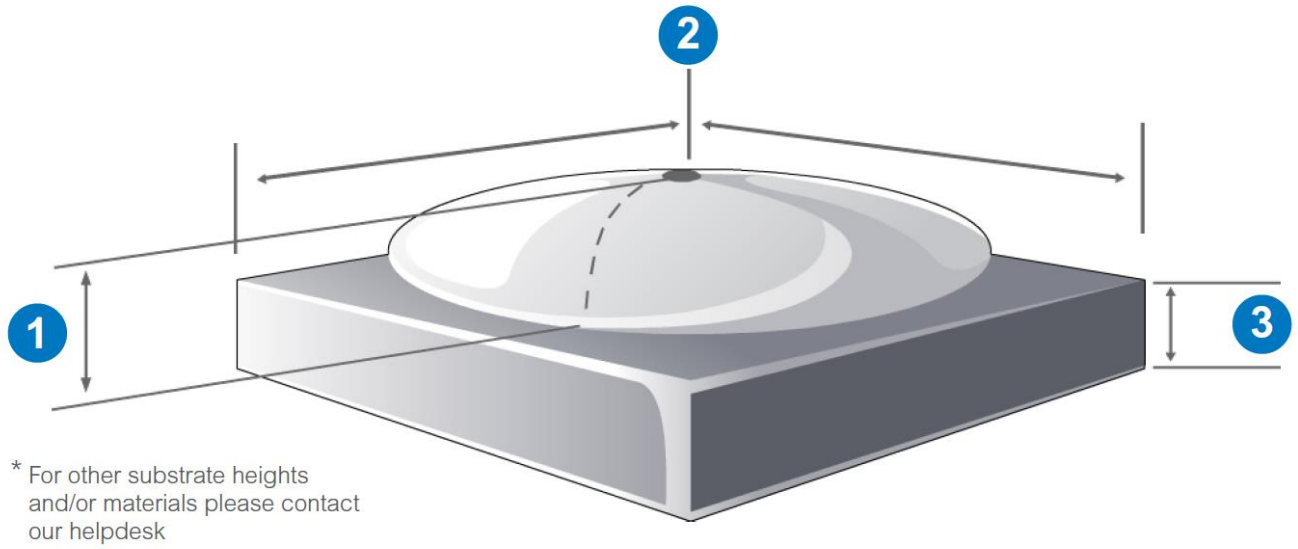
Step 1:
Print first positive half onto substrate

Step 2:
Print mold negative (part holder)

Step 3:
Flip 1st positive and load in holder

Step 4:
Print 2nd positive onto flat 'bottom' of 1st positive

Printoptical Capabilities | Design Guidelines (4)



* For other substrate heights and/or materials please contact our helpdesk

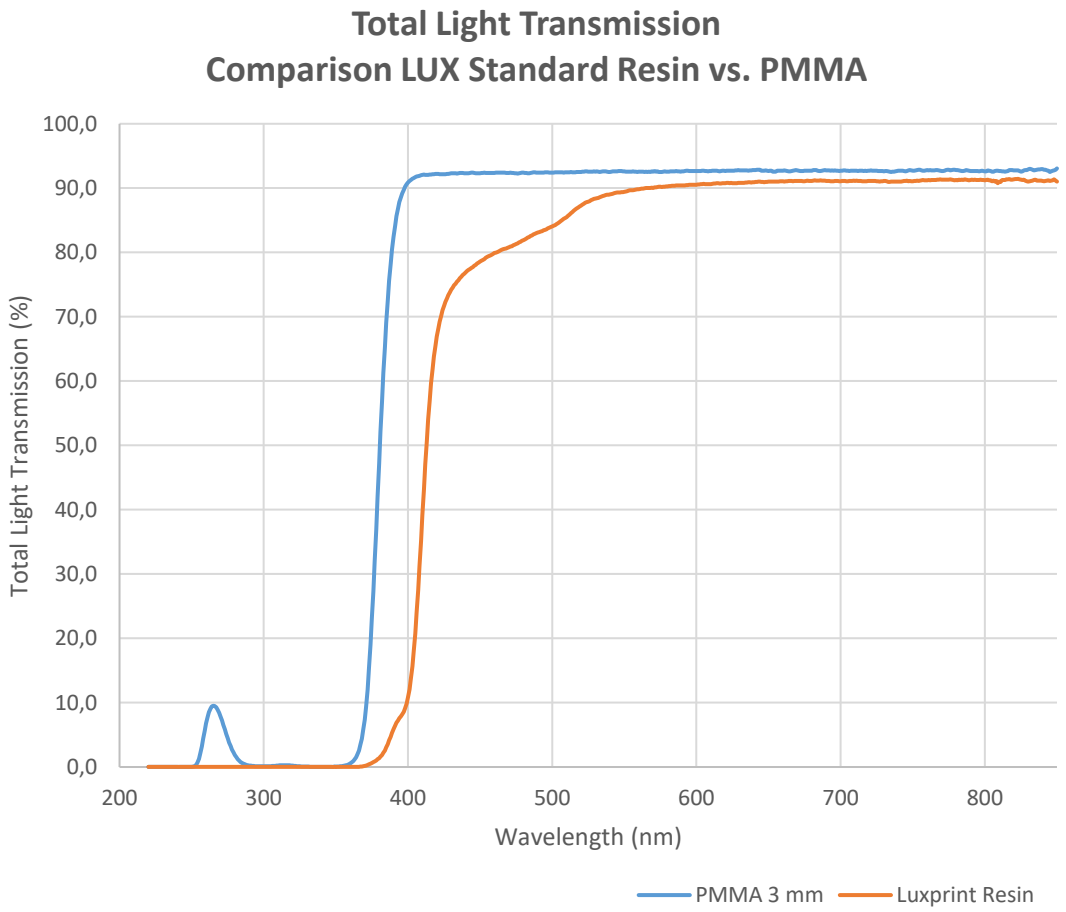
1 Select lens height	2 See max size	3 See min. substrate height*
Max Lens height (mm):	**Max Lens and Substrate size (LxW)** (mm):	**Min Substrate height** (mm):
6 mm (0.236”)	200 mm x 200 mm (7.874”)	4 mm (0.157”)
3 mm (0.118”)	600 mm x 600 mm [(2)] (23.622”)	3 mm (0.118”)
2 mm (0.079”)	1000 mm x 610 mm [(2)] (39.370” x 24.016”)	2 mm (0.079”)

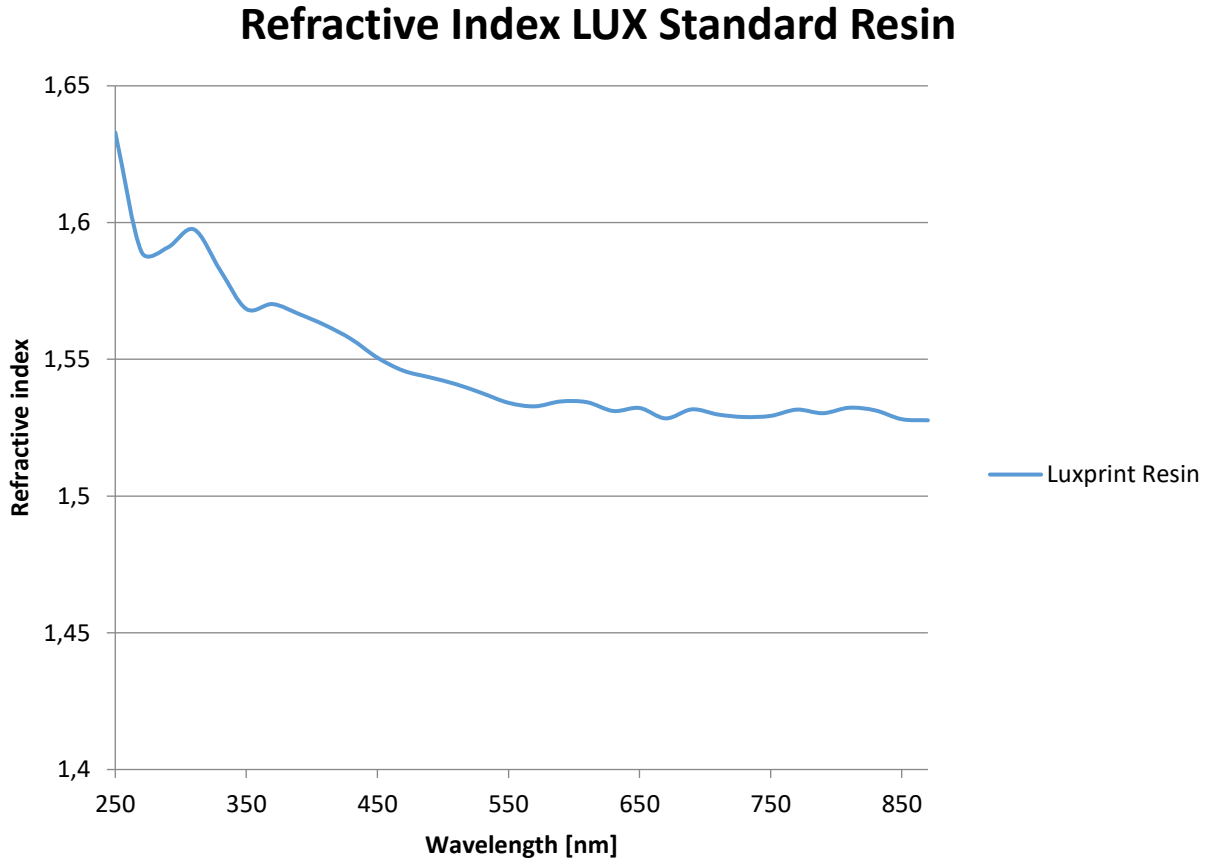
Supported CAD File Formats:

.SLDPRT / . SLDASM (SolidWorks)
.IPT / .IAM (Inventor)
.DWG / .DXF (AutoCAD)
.RAY (Photopia)
.STP / .STE / .STEP / .STL / .IGES

Datasheet available at:
www.luximprint.com/printoptical-capabilities

Printoptical Capabilities | Material Specifications | **LUX Standard**



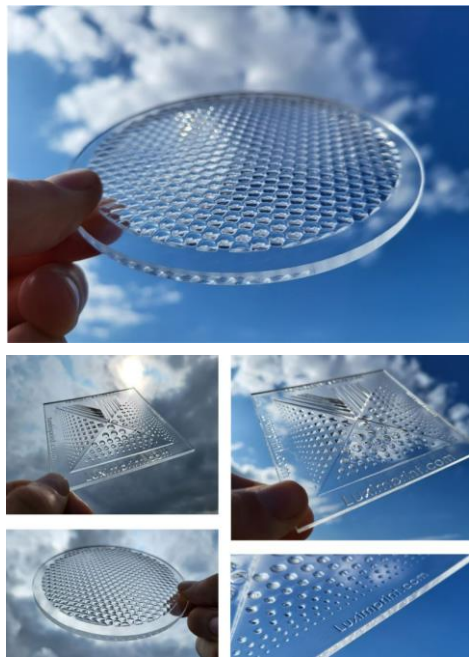


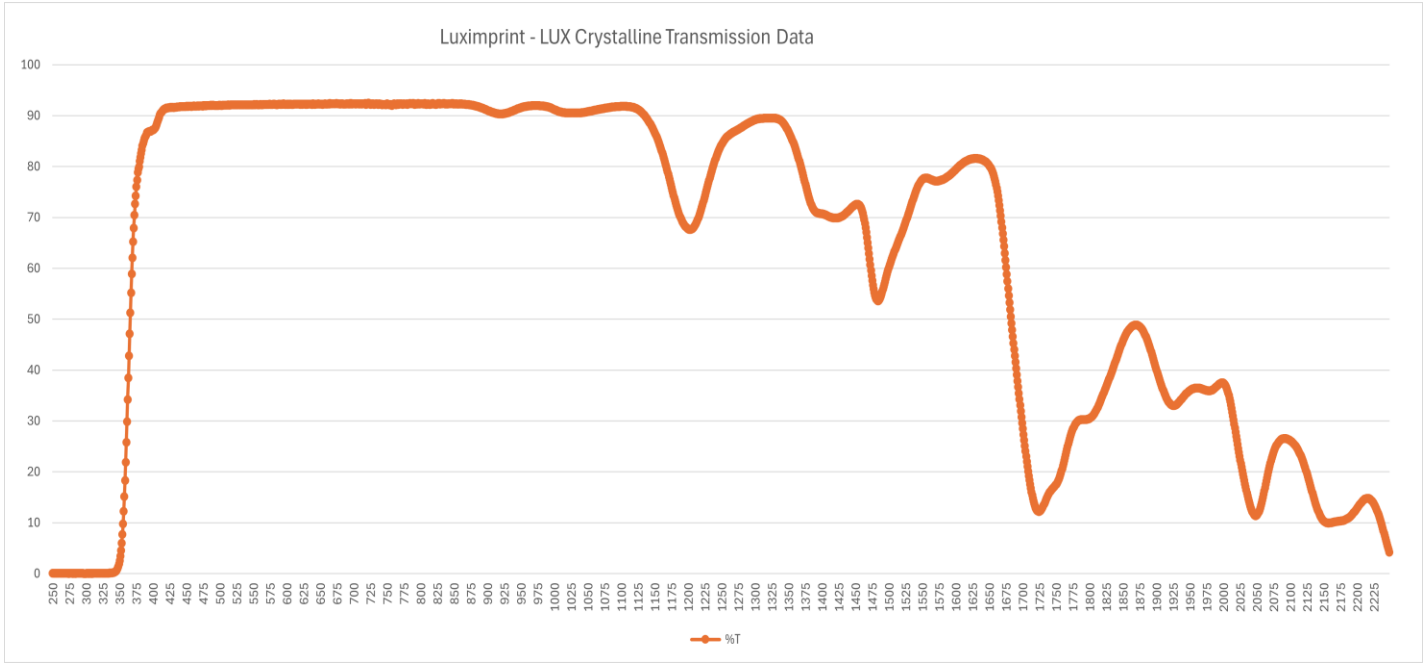
High transmission : 99,4% internal transmission / 90% ext. (avg.)
Low haze values : 0,1% (@1mm)

Average RFI : 1.540
Abbe nr. : 41

Printoptical Capabilities | Material Specifications | **LUX Crystalline**

‘LUX Crystalline’ resins are developed for use in more challenging environments. The stunning combination of superior thermal, mechanical and optical properties allow for the use of the materials in more challenging environments. When reliability, durability and superior optical clarity are leading for your application, ‘LUX Crystalline’ is the material of choice.





LUX Crystalline Resin

Measurement:
3.0 mm sample plaque

For internal transmission:

Typical surface reflection values are ± 3% per entrance/exit surface.

- High temperature resistence (90 degr C)
- Single material solution
- Color / milky material possible
- Enhanced U.V. resistance

Datasheet available at: www.luximprint.com/printoptical-capabilities

Refractive index: n = 1.507 @589 nm (PMMA-like)

Printoptical Capabilities | Surfaces & Finishes | Frosted Finishes (1)

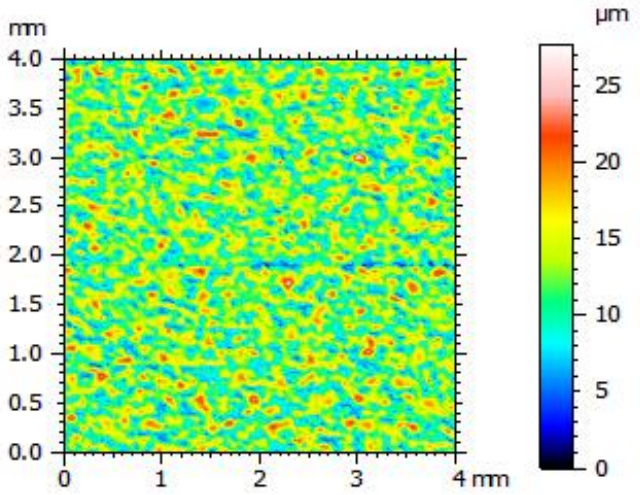
Printed optics can either have ‘optical smoothness’ or ‘defined roughness applied to its surfaces, or a combination of both.

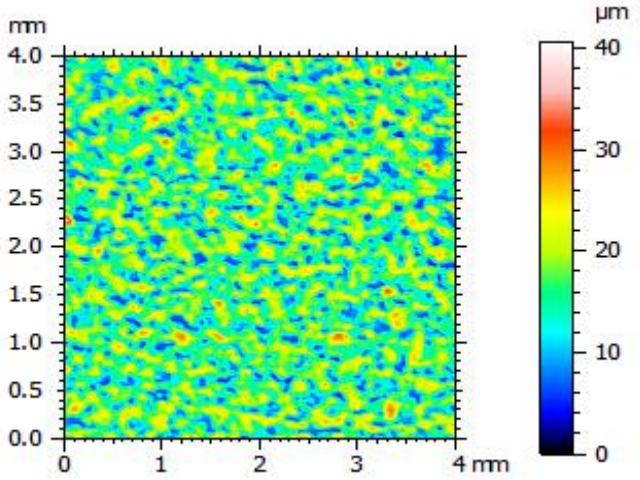
- **Smooth Surface Finishing:**
  Optimal functional performance

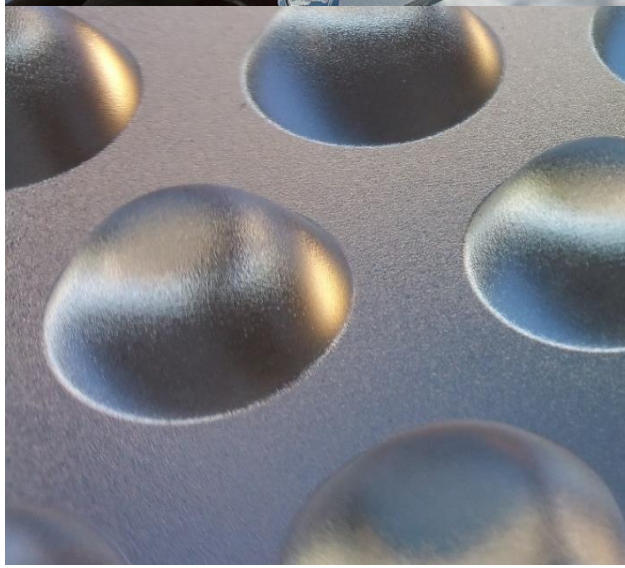
- **Frosted Surface Finishing:**
  Defined Roughness for:

  1. Diffusivity (dispersion of light)
  2. Visibility (decorative, look through rate)
  3. Protection (anti-glare, avoid blinding)
  4. Matte reflective finishes

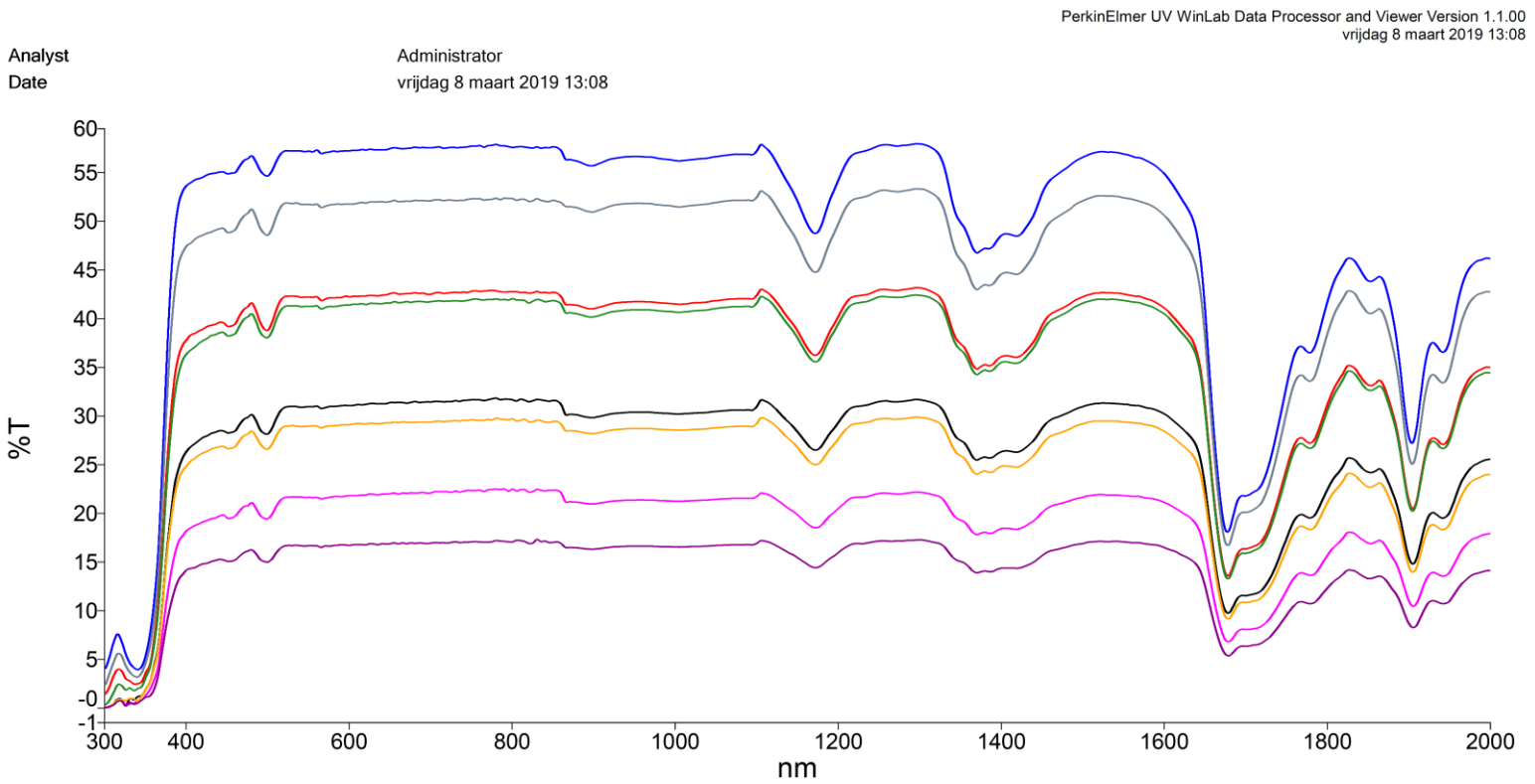
Datasheet available at: www.luximprint.com/printoptical-capabilities



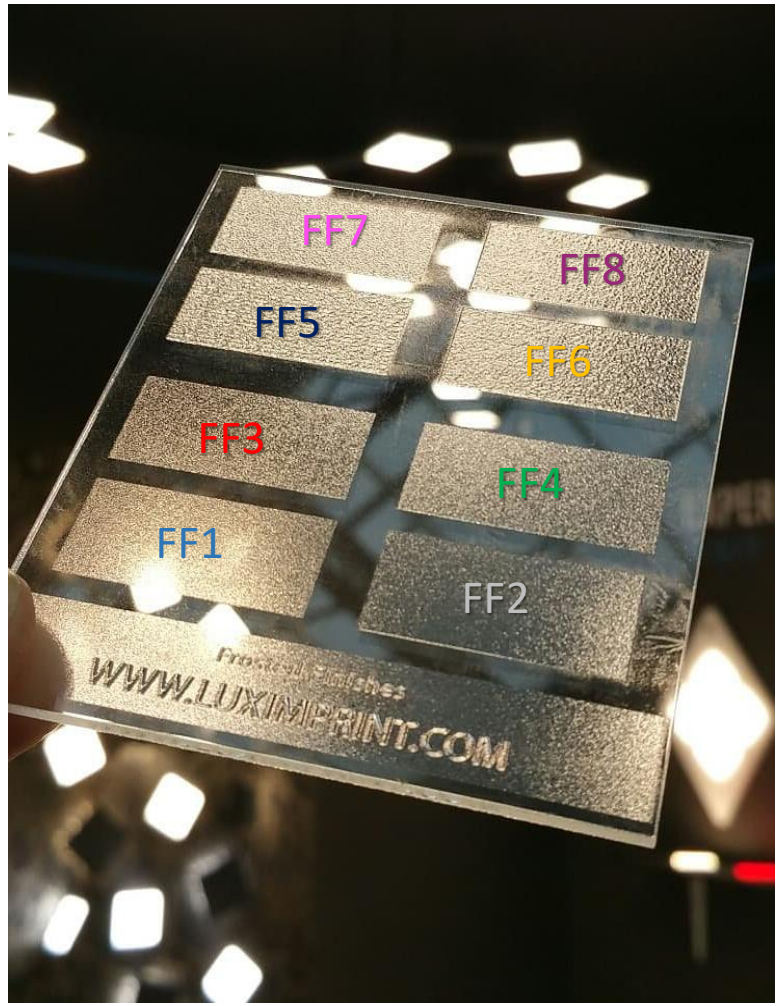




Printoptical Capabilities | Surfaces & Finishes | Frosted Finishes (2)



% specular transmission Luximprint Frosted Finishes at normal incidence (300 – 2000 nm)



Datasheet available at: www.luximprint.com/printoptical-capabilities

// PRODUCTS & SERVICES

TECH TRANSFER TO SOLUTIONS

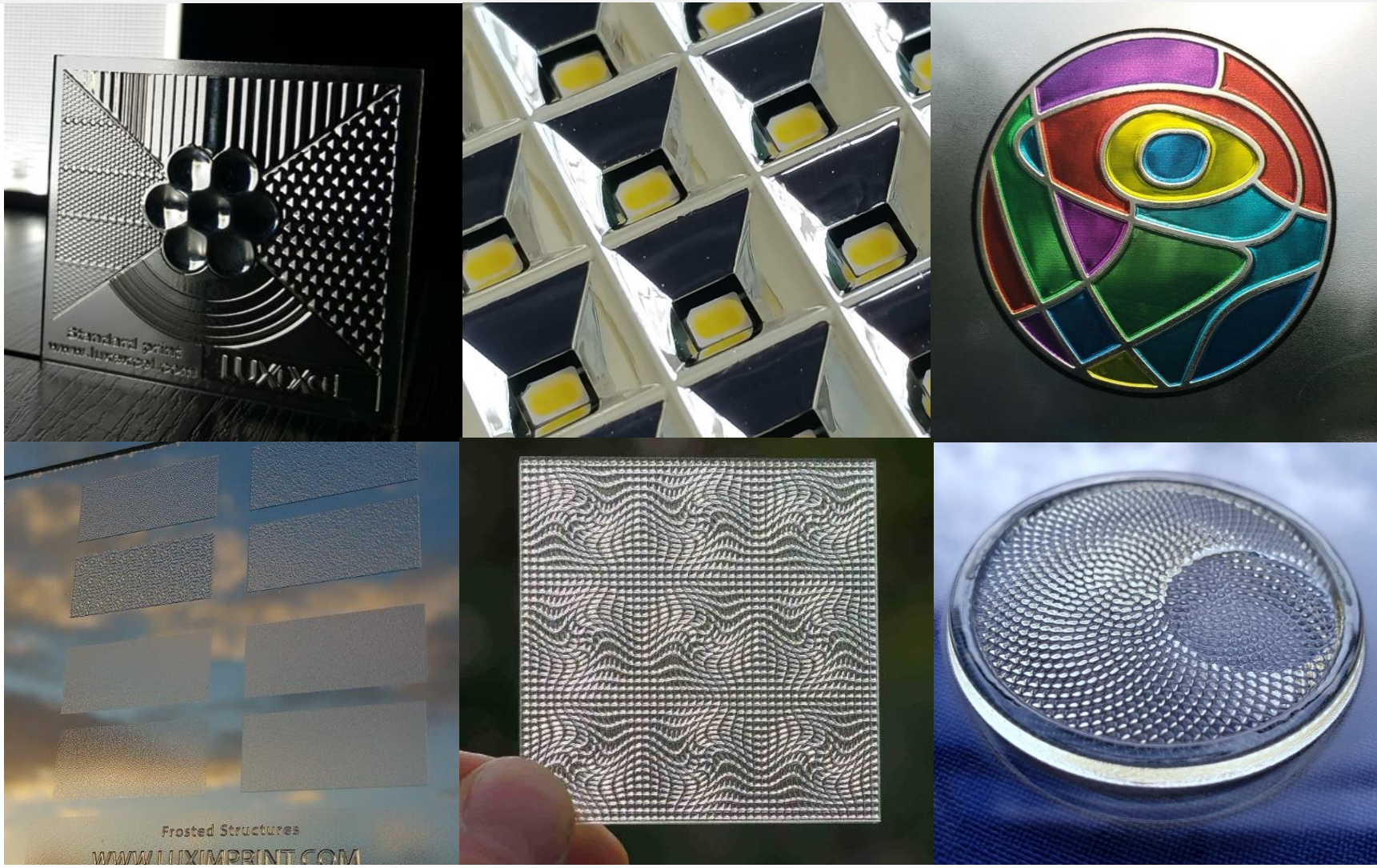
LUXIMPRINT

Product Groups

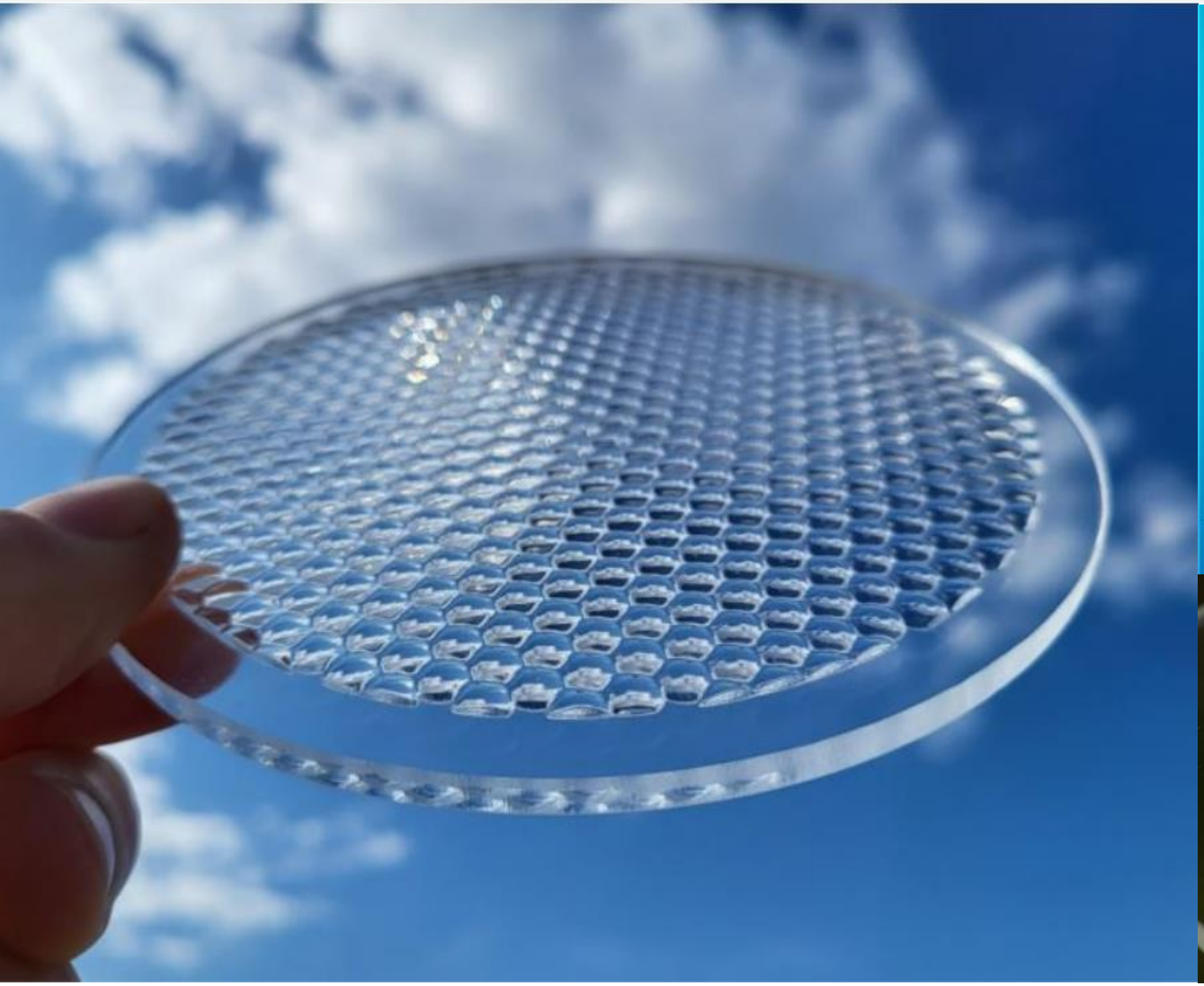
Main product groups:

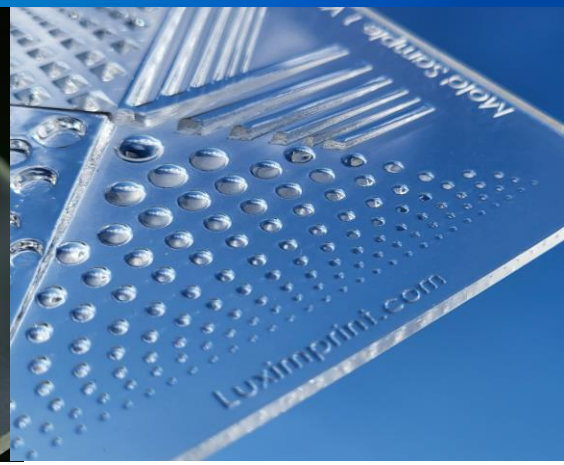
- Printed optics
- Printed reflectors
- Optographix
- Printed diffusers
- Textured surfaces
- Printed Molds & Tools

Custom work only!

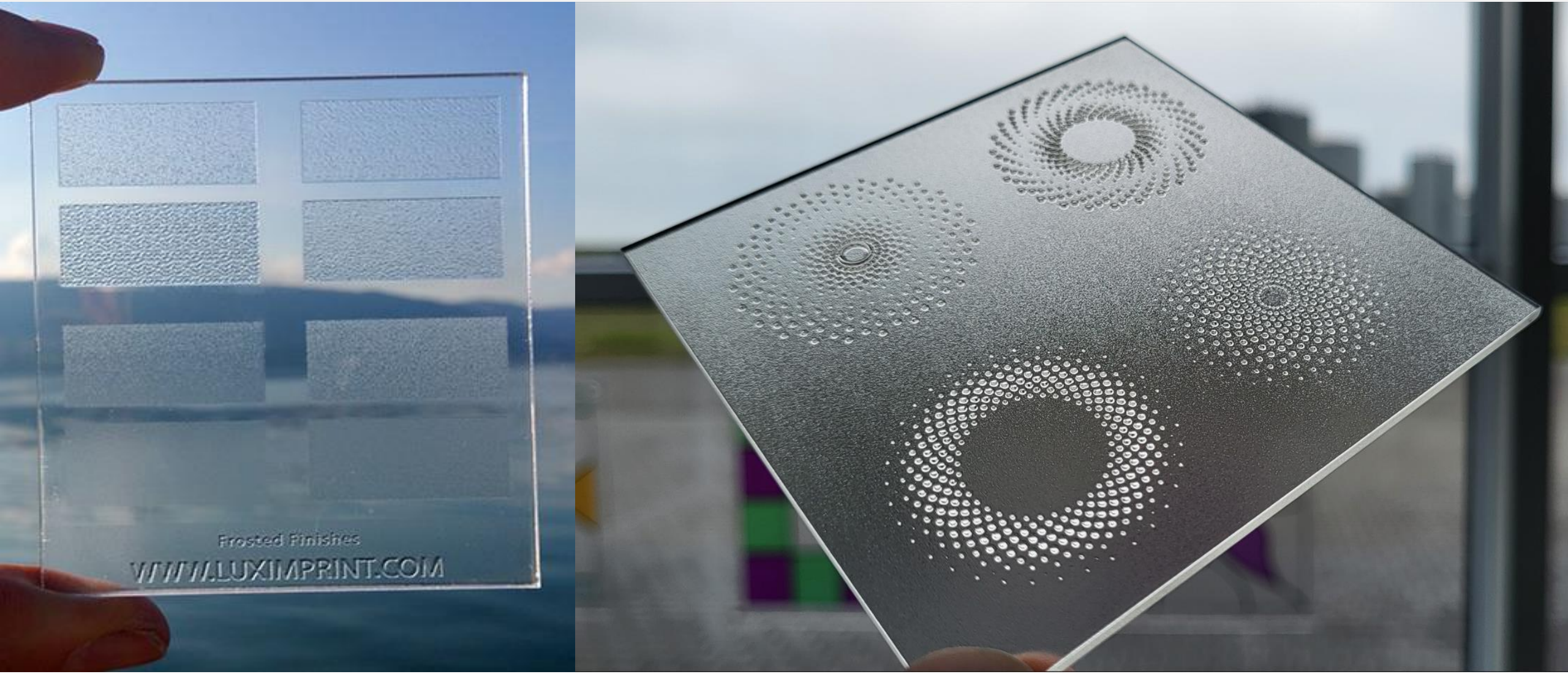


Printed Optics / Smooth Surfaces

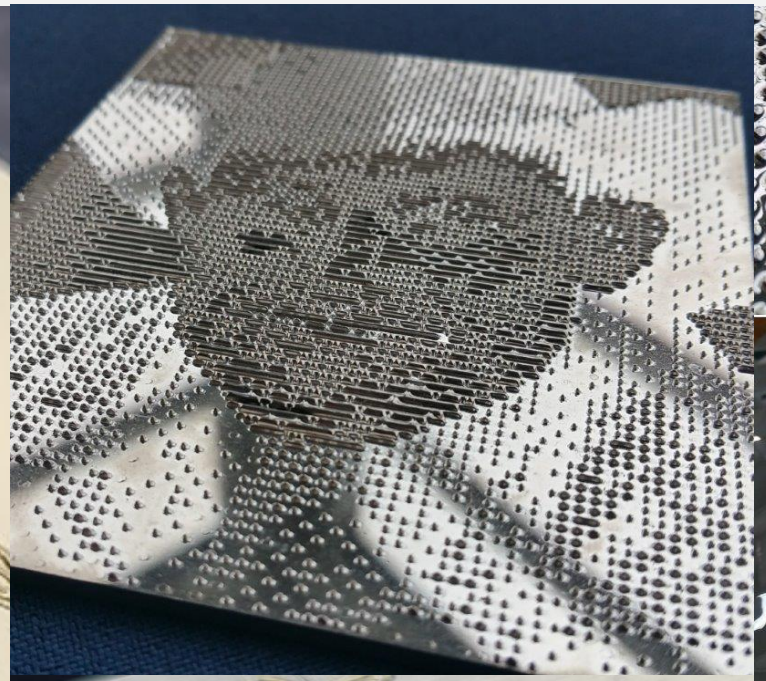


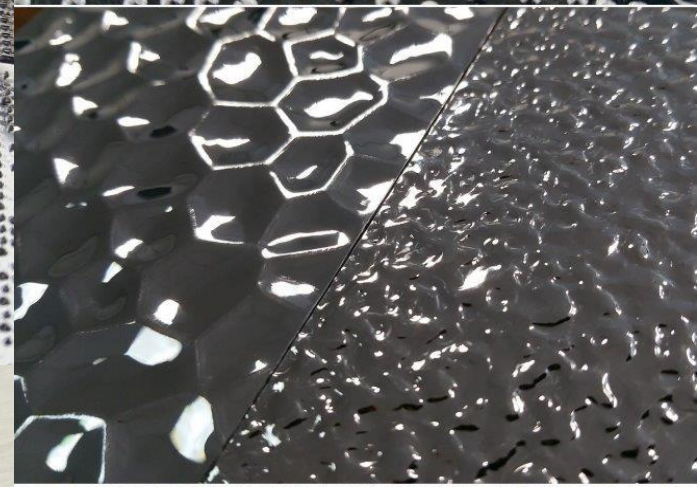


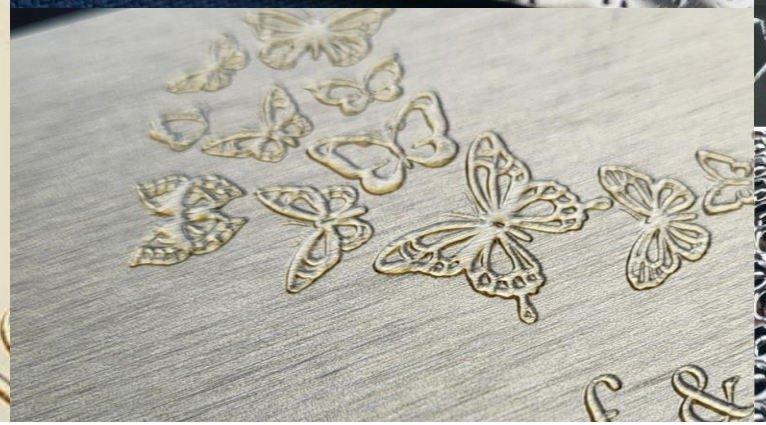
Printed Diffusers / Frosted Finishes



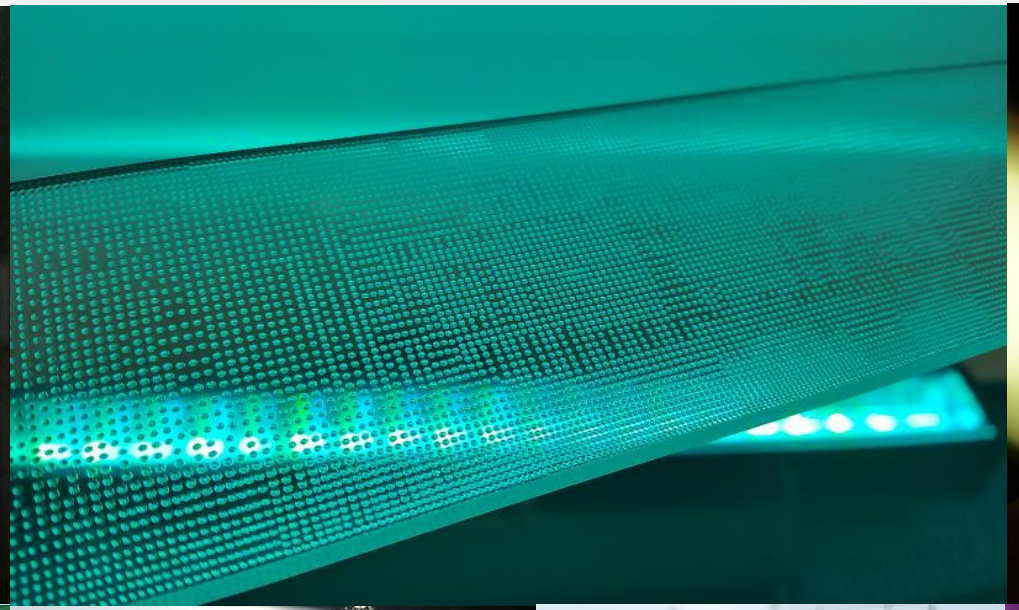
Printed Reflectors / Reflective Surfaces

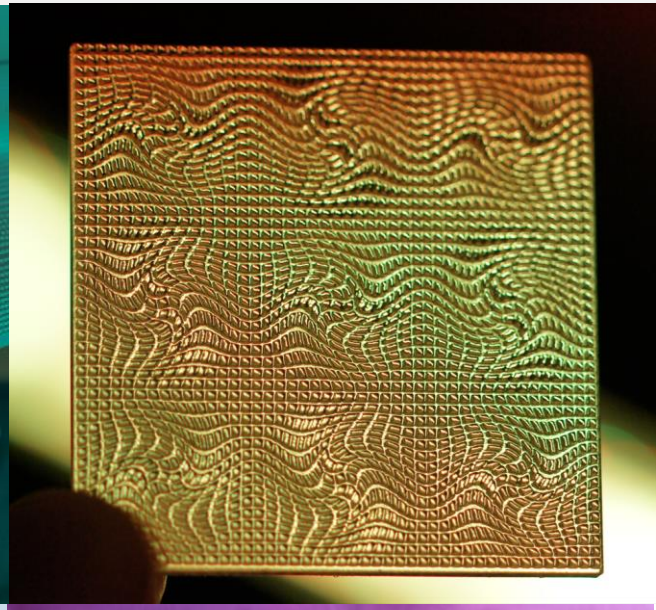


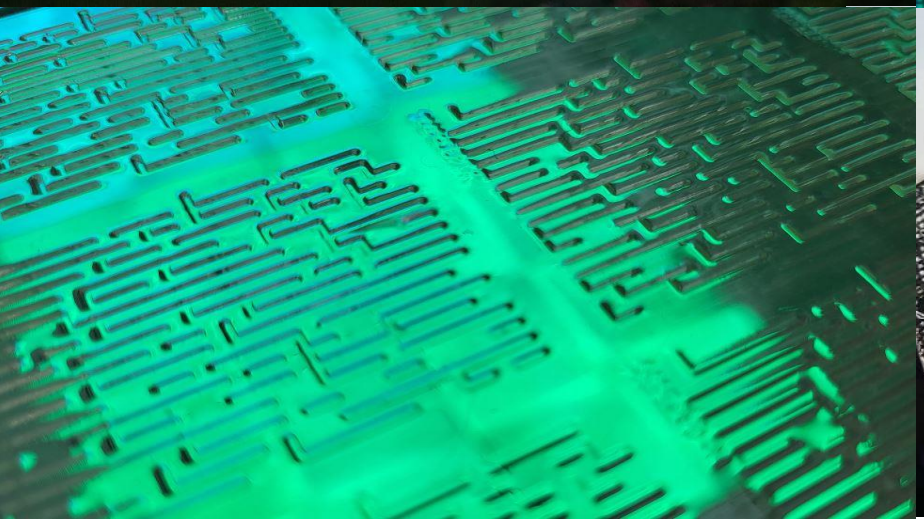


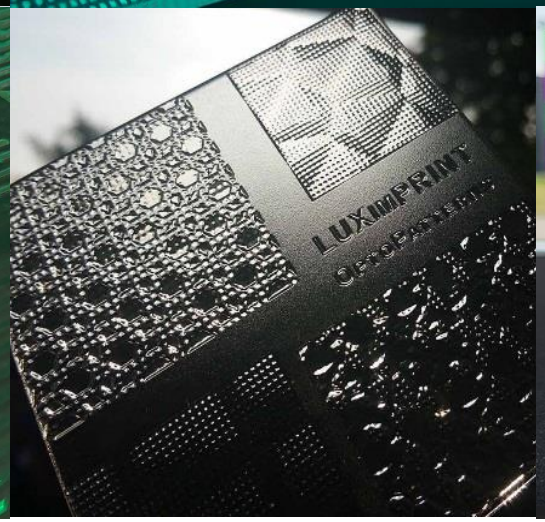


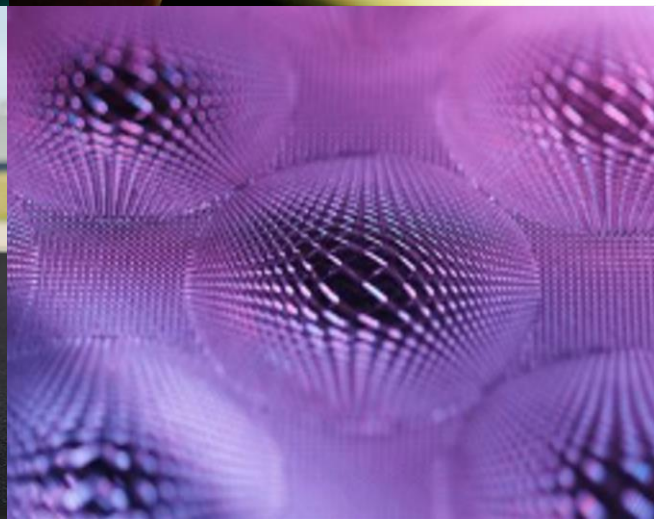
Printoptical Textures | Luminous Textures and Patterns



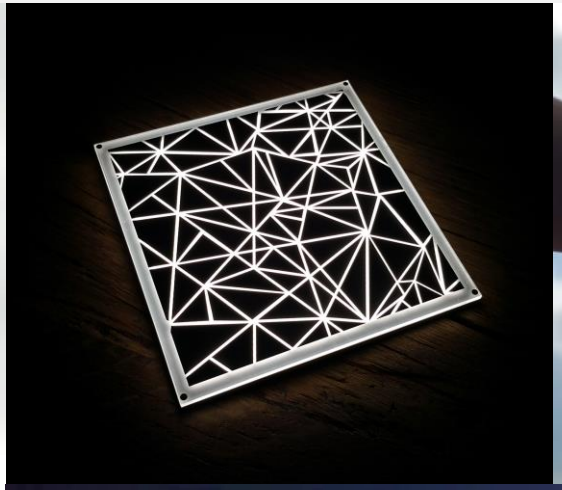




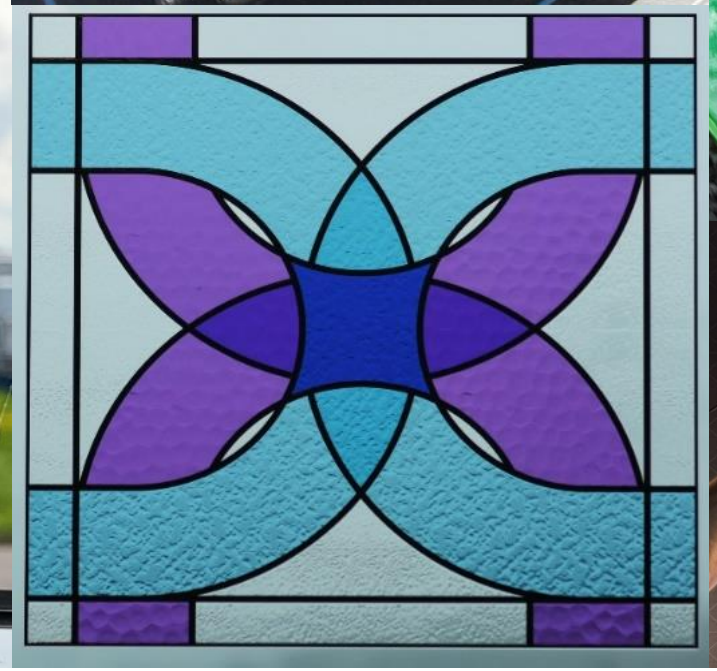


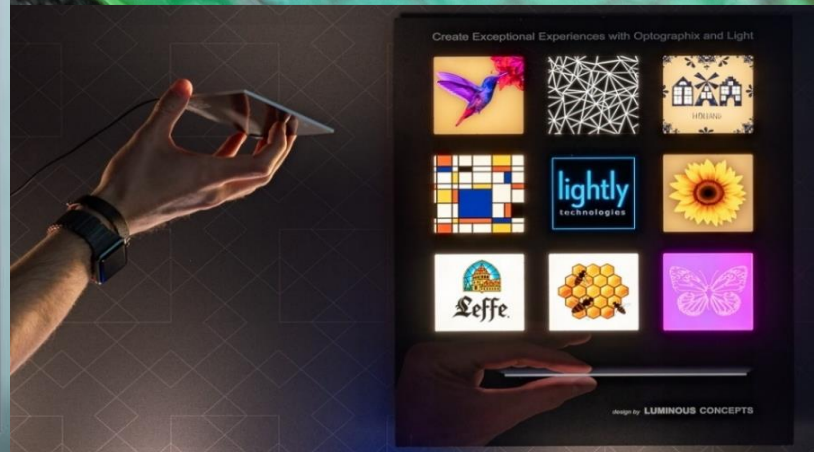


Optographix / Black & White Masking



Optographix / Branding with Light





Printoptical Art / Colorful 3D Art

// CONNECTING THE DOTS

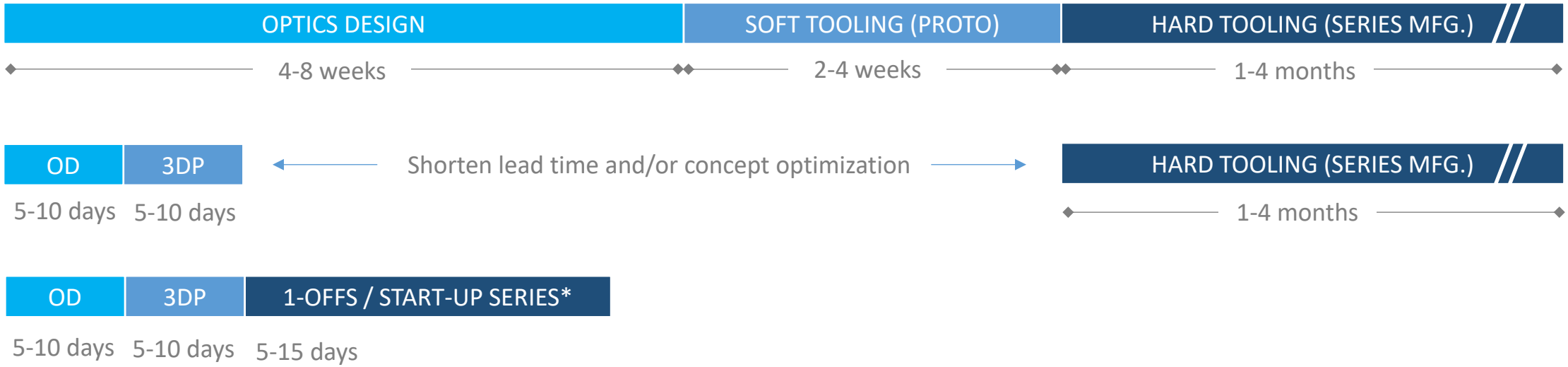
DESIGN VS. MANUFACTURE

LUXIMPRINT

Design vs. Manufacture of Custom Optics

- **Additive Optics Design meets Additive Optics Fabrication**
  - Design for Manufacture (DFM) considering optical 3D printing capabilities;
  - Software incorporates also ‘conventional tech capabilities’;

- **Typical Development Cycle of Conventional vs. 21st Century Optics**



*) If applicable

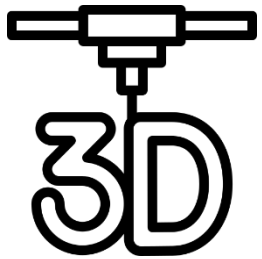
PROCESS USP'S AT A GLANCE

3D MANUFACTURE

Speed

Flexibility

Cost-efficiency



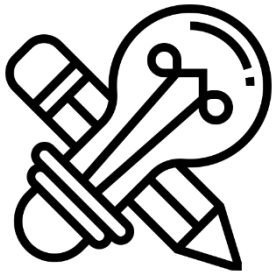
CUSTOMIZATION = KEY

INNOVATION/DESIGN

Customization (Tailored to Customer needs)

Complexity (Complexity for Free)

Creativity (Full Design Freedom)



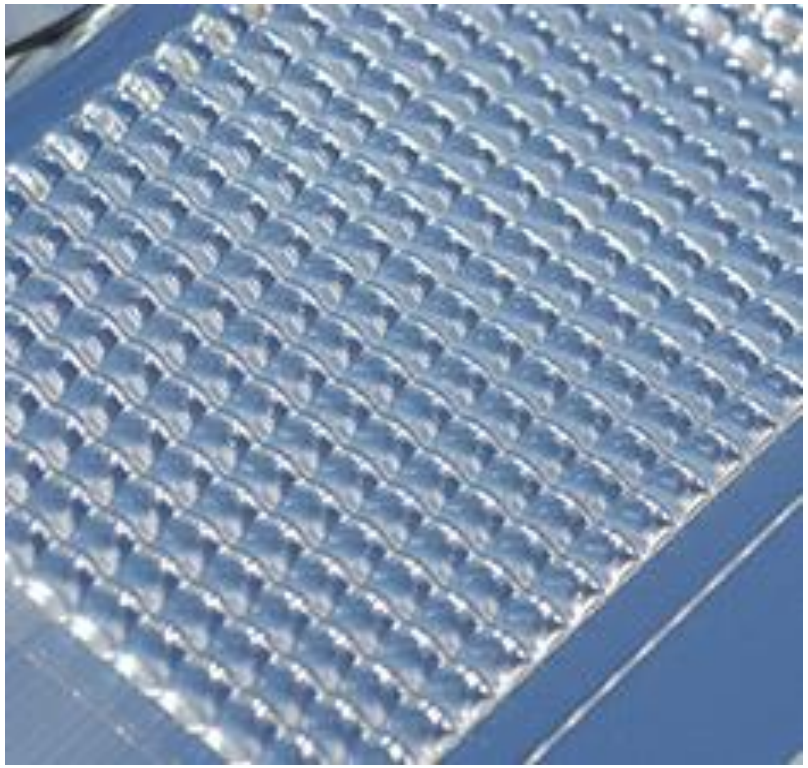
// USE CASES

Reference Applications

LUXIMPRINT

OPTIS | Pillow Lens Arrays

AUTOMOTIVE



Credits: Optis – www.optis-world.com

Automotive pillow lenses are used to ideally diffuse the light from roof to a reader in a car.
In an automotive interior: you need to be able to light a standard sized page in front of the steering wheel with the reading lamp. To achieve this, each pillow lens needs to have different parameters for its curvature radius and inclination angle. Such complex pillows can be easily achieved with Printoptical Technology.

University of Rochester | Institute of Optics / Arzon Solar

SOLAR

Image credits: *Arzon Solar*

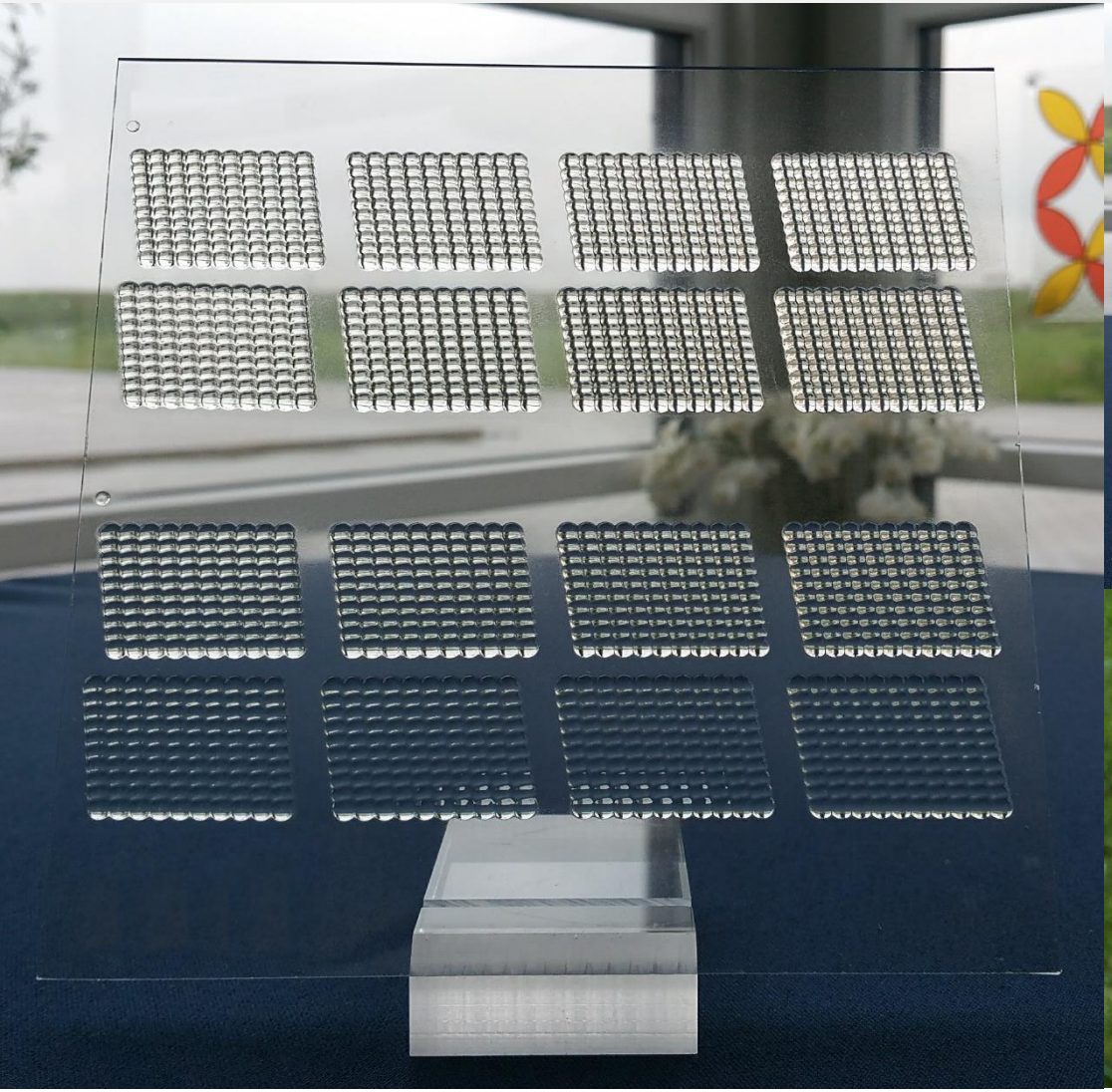
UNIVERSITY of ROCHESTER

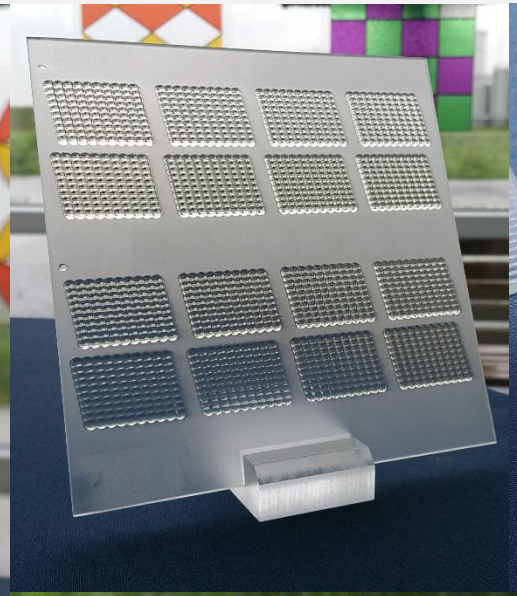
The Institute of OPTICS

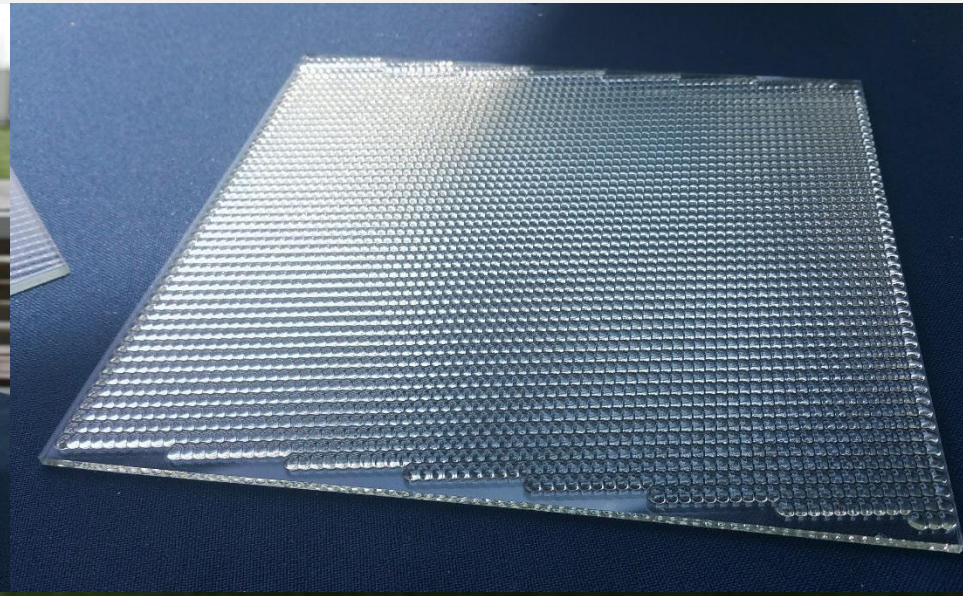
ArzonSolar
Powered by AMONIX Technology

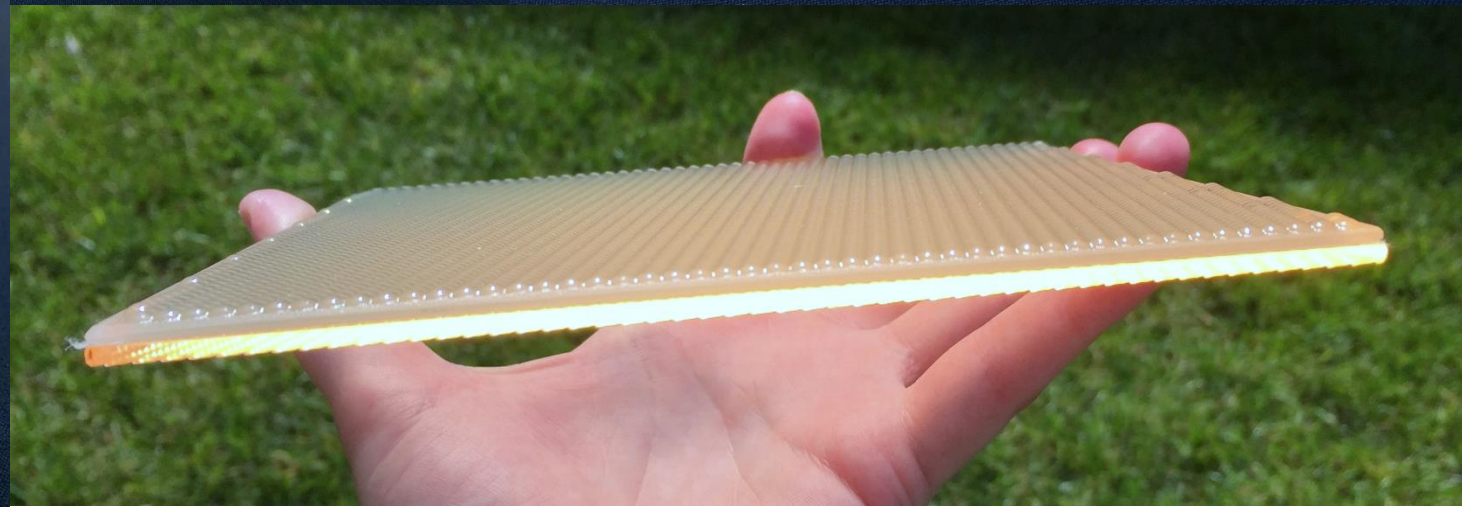
University of Rochester | Institute of Optics / Arzon Solar

SOLAR



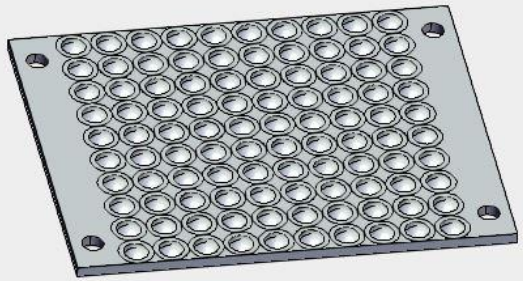


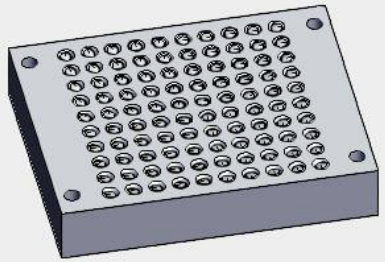


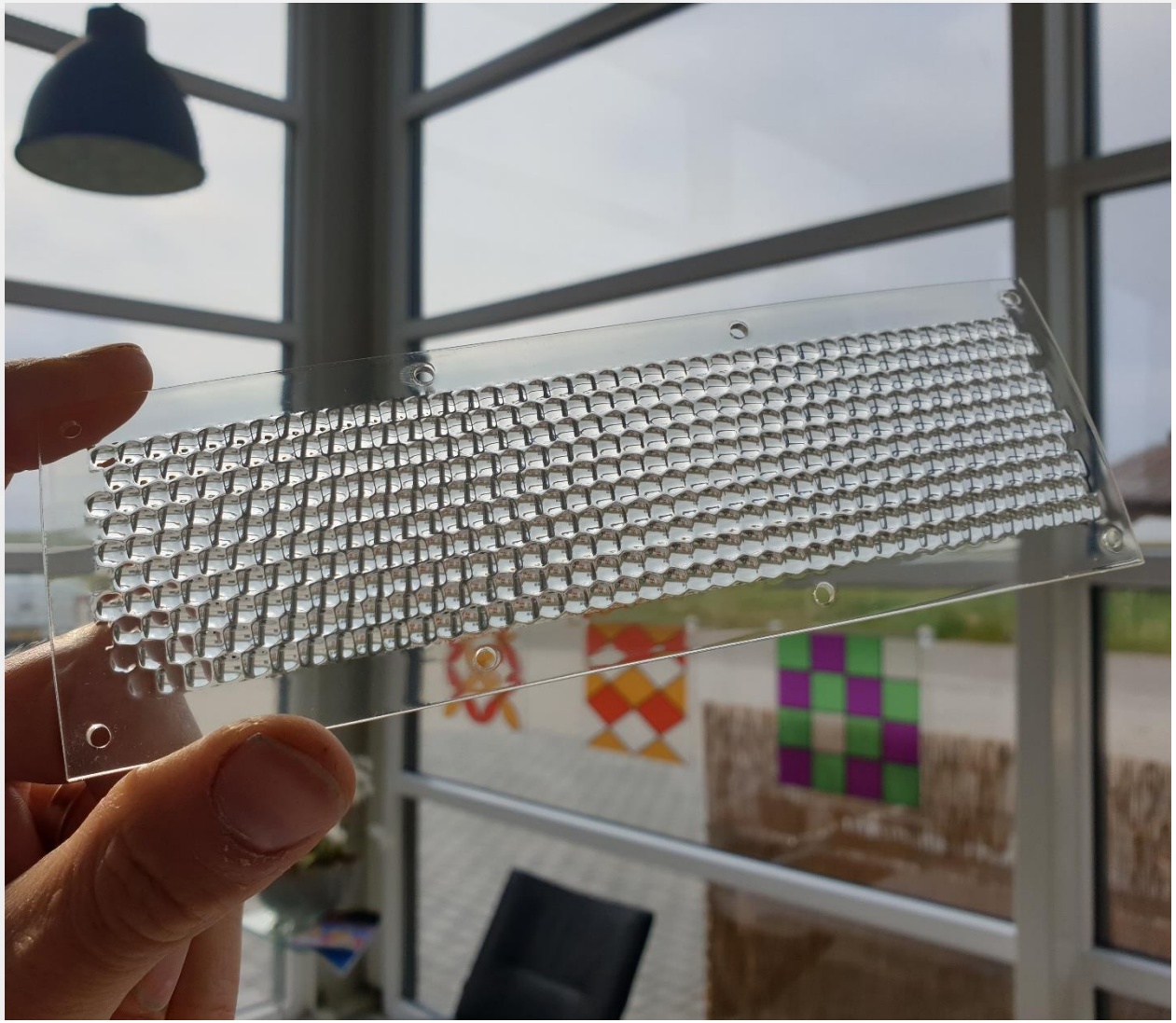


Realfiction | Holographic TV w/ directional pixel technology

HOLOGRAPHY







A unique and patent pending directional pixel technology enabling holographic multiuser OLED and LCD displays.

Realfiction | Holographic TV w/ directional pixel technology

HOLOGRAPHY

STUDIO HELDER DESIGN | DDW 2024 | ‘SCHERMLICHT’

EVENT LIGHTING

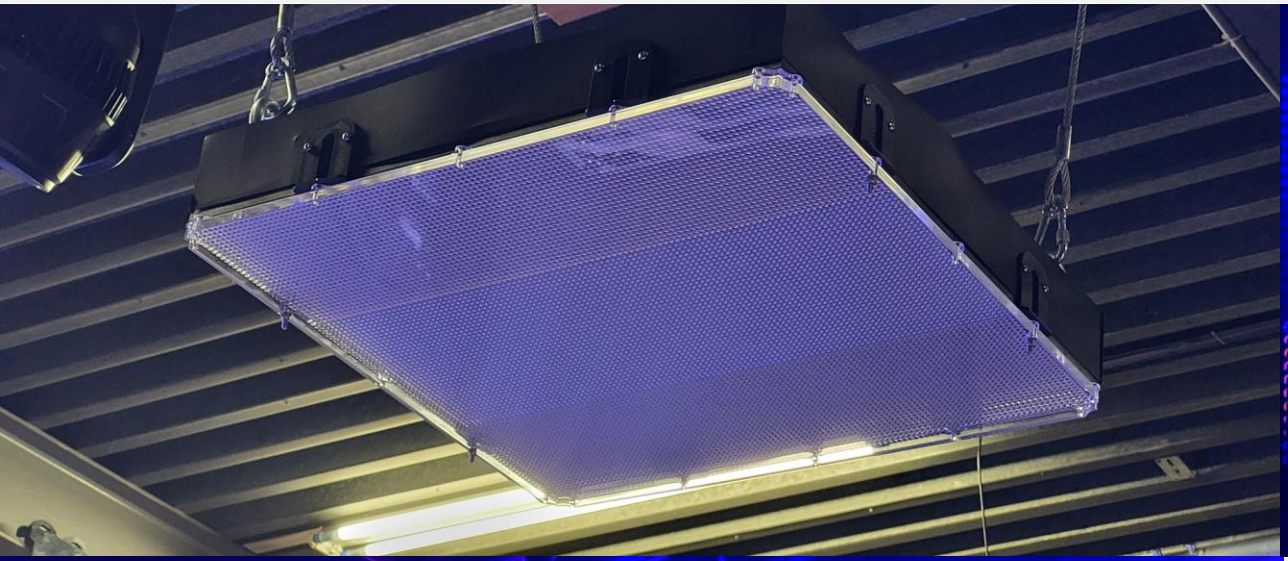
Schermlicht represents the latest exploration into reimagining the role of LED screens within day-to-day environments.

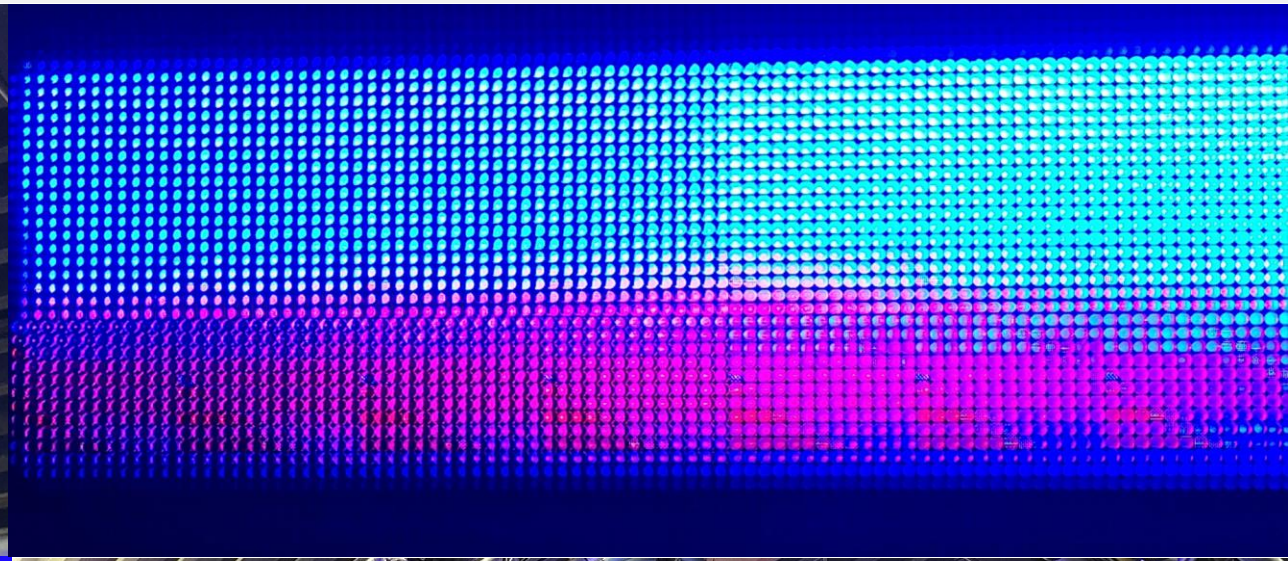
A space of light created by an immersive screen installation, a space constructed by screens, sound and movement to create a moment of contemplation.

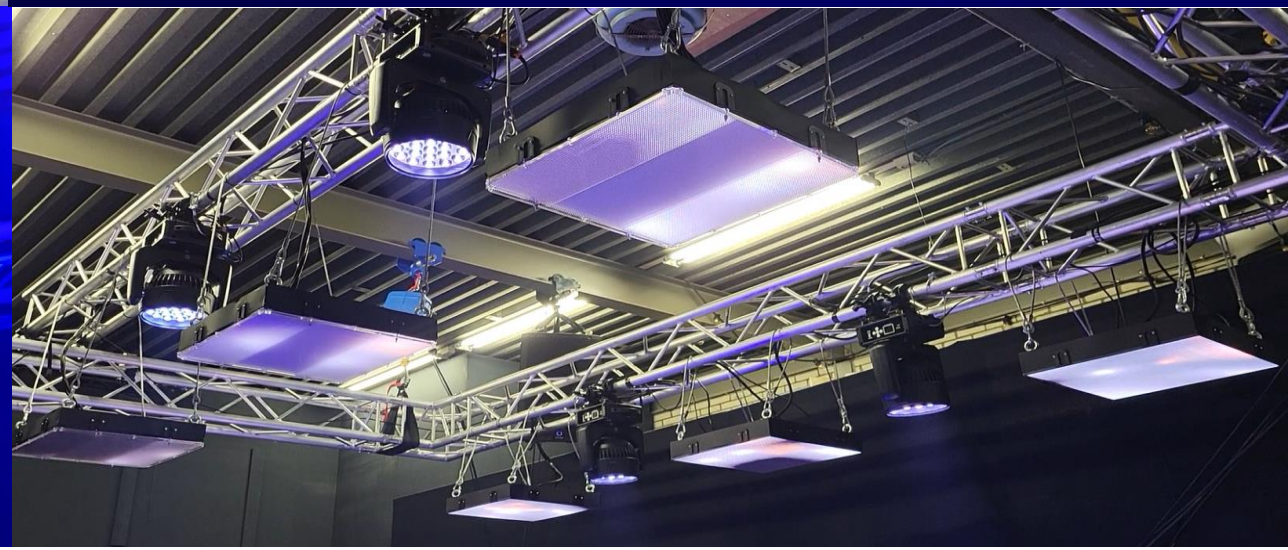
Dutch Design Week Eindhoven

STUDIO HELDER DESIGN | DDW 2024 | ‘SCHERMLICHT’

EVENT LIGHTING

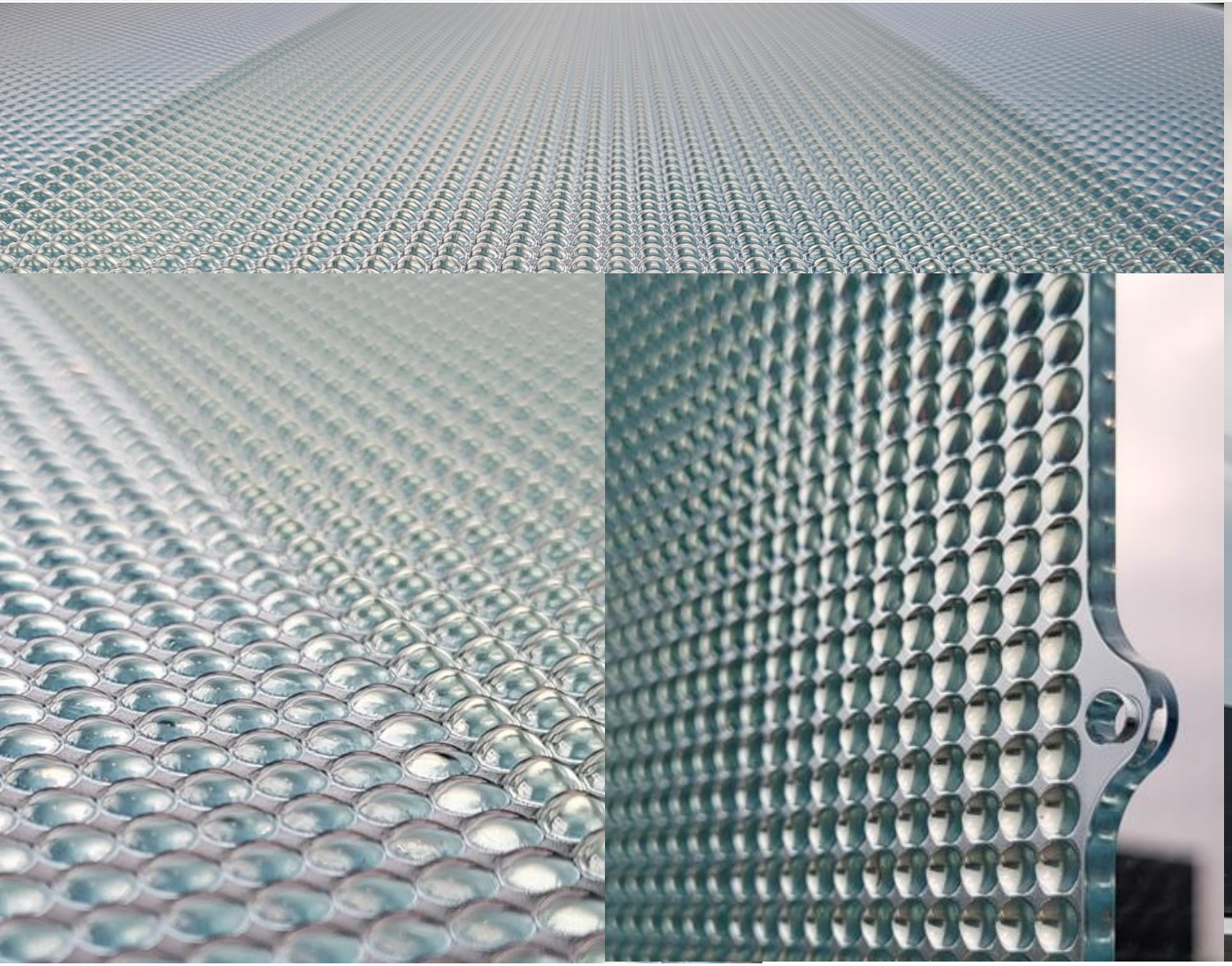


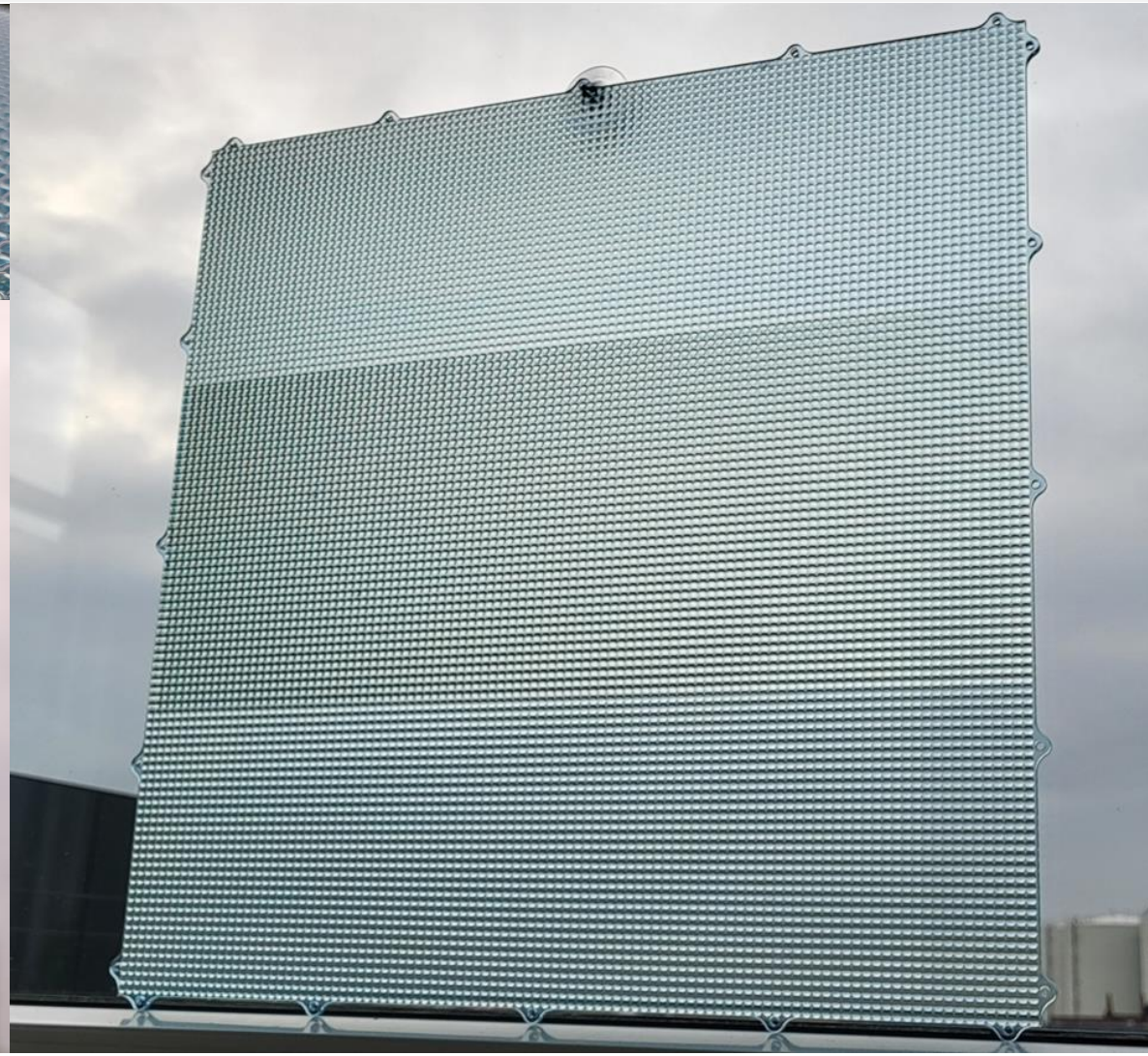




STUDIO HELDER DESIGN | DDW 2024 | ‘SCHERMLICHT’

EVENT LIGHTING





// Wrapping-Up

What have we learned today?

LUXIMPRINT

Lessons Learned

- **Thoughts to take home…**

- **Printoptical Technology:** Fast, Flexible and Cost-Effective way of getting your CUSTOM items available for inspirational/functional demonstration and/or mold-tooling validation;
- **Toolless Fabrication:** Prototyping and pre-small series manufacture; On Demand – to Demand.
- **Smart Design Options:** Mathematic design methods for custom optics without compromises;
- **Combination of new Optics Design and Manufacturing Methods** is extremely powerful;
- **Full Design Freedom:** New design opportunities are here;
- **Living Textures:** Optical materials + light generate ‘vivid’ textures and new ways of interacting (reflective/diffractive);
- **Mindset Change:** Working with digital technologies requires a different approach: it breaks through established boundaries and widens possibilities, goes beyond imagination!

THANK YOU!

Welcome for a visit at the Expo booth!

Connect with us

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