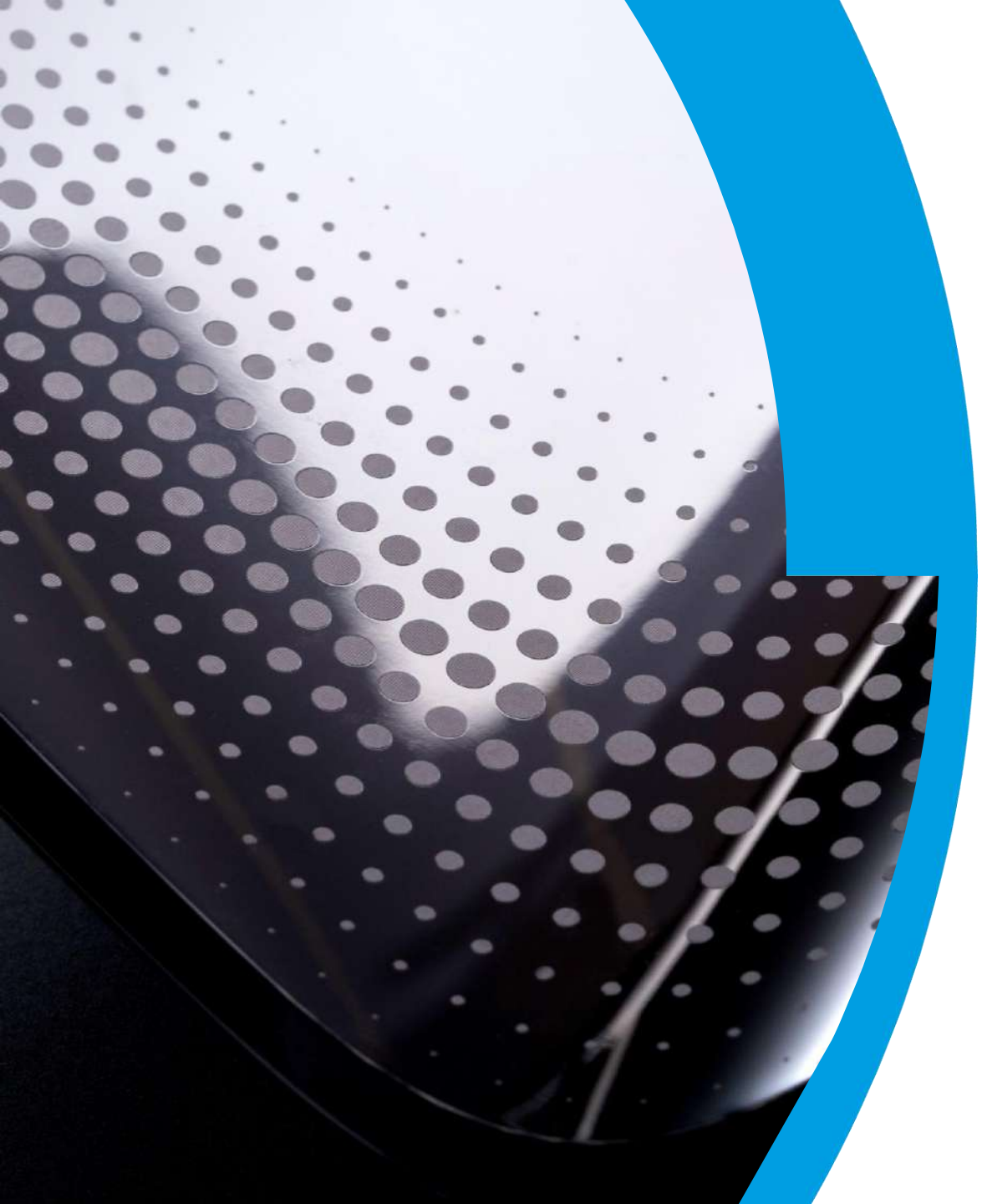


From Pixel to Real Part

Creating Infinity Light Effects with Makrolon® and Imagio®

DVN INTERIOR EVENT – TORINO , 14th -15th JANUARY 2026

HOW CMF, DESIGN AND SUSTAINABILITY MERGE FOR FUTURE AUTOMOTIVE INTERIORS

Table of content

Design Concept & Market Trends

Elevating Automotive Interiors

Automakers are elevating ambient lighting from a comfort feature to a strategic brand lever.

Innovative light design is becoming a key differentiator, creating emotional connections that influence purchase decisions and loyalty.

OEMs increasingly deploy lighting effects to add perceived depth and spaciousness in compact interiors, while immersive, customizable lighting signatures reinforce brand identity across model lines.

This shift positions in-cabin lighting as a core element of experience design — and a new arena for competitive advantage.

The OEM Challenge

Current Interior Lighting Development

- Multiple physical prototypes required
- Unpredictable light output results
- Long development cycles (12-18 months)
- High tooling costs for iterations
- Limited design freedom with traditional light guides

- The Vision:
  Digital design to physical reality of optical demanding parts with minimal development iterations

- The Task:
  Development of infinity light effects for automotive applications
- Provide tools to reduce time-to-market in automotive development
- Thin-wall design for weight reduction and space optimization
- Mono-material approach enhancing sustainability and recyclability
- A Collaborative approach across the value chain

The Material Effect

FROM PIXELS TO FINISHED PART.

DISCOVER HOW PHOTOREALISTIC RENDERINGS LET YOU VISUALIZE LIGHTING EFFECTS EVEN BEFORE A SINGLE PROTOTYPE IS BUILT.

IMAGIO® HIGH-QUALITY OPTICAL MATERIAL DATA, COMBINED WITH EXPERT DIGITAL SIMULATION AND ADVANCED TEXTURING, ACCELERATES YOUR DEVELOPMENT CYCLES.

LET‘S SPARK BRILLIANCE IN YOUR NEXT LIGHTING SOLUTION.

The collaboration partners

Design Partner

NORTHERN WORKS

Simulation Expert

ECLAT DIGITAL

Laser Engraving specialist Expert

Film Expert

NISSHA

Material Expert

From pixel to real part.

From Computer simulation to physical processing

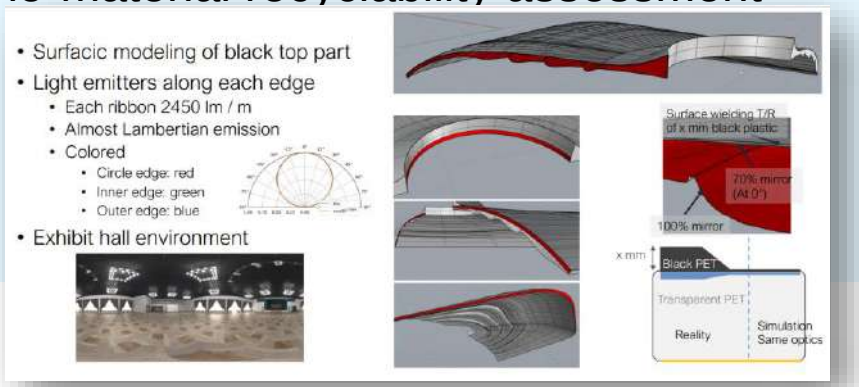
Phase 1: Computer Simulation

Optics:

- IMAGIO® OMD: Optical material date as input for digital simulation in *Ocean* by **Eclat Digital**
- Advanced light ray tracing models for visual effect simulation

Part

- Space-saving: Geometry optimization of rather thin-wall part compared to achieved depth effect with feasibility validated by MoldFlow
- Mono-material recyclability assessment



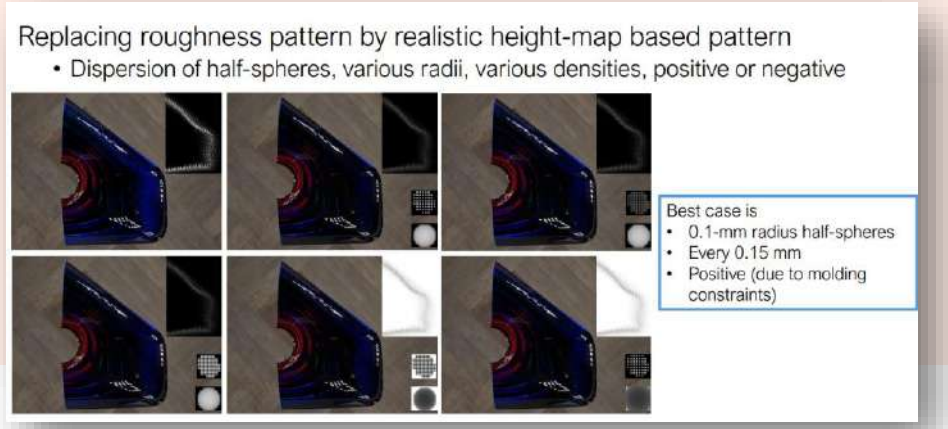
Phase 2: Physical Processing

Injection Mold:

- Mold manufacturing based on digital simulations: 2K injection molding + FIM
- Single-material construction for end-of-life recyclability

Laser engraving

- Precision laser engraving of mold surface for light diffusion patterns by **PelPlastic**



Material Innovation Meets Design

Mono-Material Approach for Sustainability

- Single polycarbonate base material
- Integrated light guide functionality with predictable light output
- Textured surfaces for controlled light distribution
- PVD coating for enhanced aesthetics
- Eliminates multiple component assembly

PHASE 1 - SIMULATION

Optical Simulations & Optimizations

BRDF, BTDF, spectral absorption and scattering coefficients for a parametric model used by optical simulation software

Imagio® Optical Material Data

High-Quality Optical Material Data for Demanding Lighting Applications

Target group: Optical Engineers

Target Application: Optical Simulations & Optimizations for quantitative design of optical parts

Exemplary Target Areas: Visibility Systems, Comfort and Driving Assistance Systems, Lighting Units

"24/7" self-service

Professional high quality optical data

Fast, easy, and comfortable material choice

Globally harmonized (just one truth) and available

Save time & money

Stay up to date with Covestro's developments and evaluations

Background information (e.g., white-papers on measurement methods)

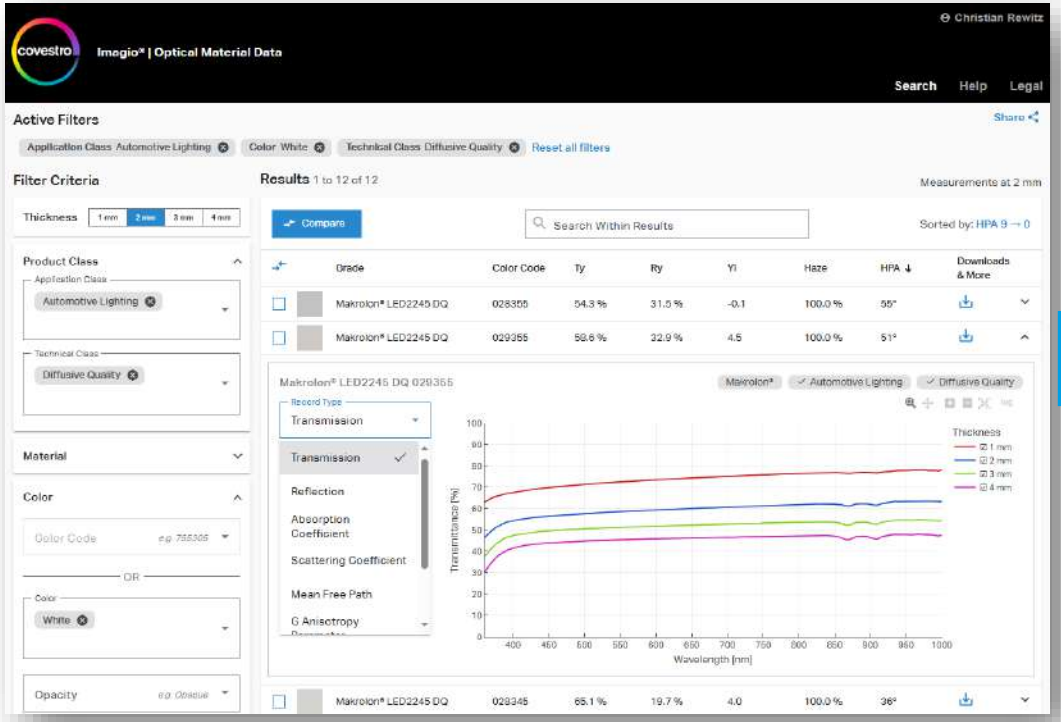
Compare products in a simple way

Open file format

Imagio® Optical Material Data

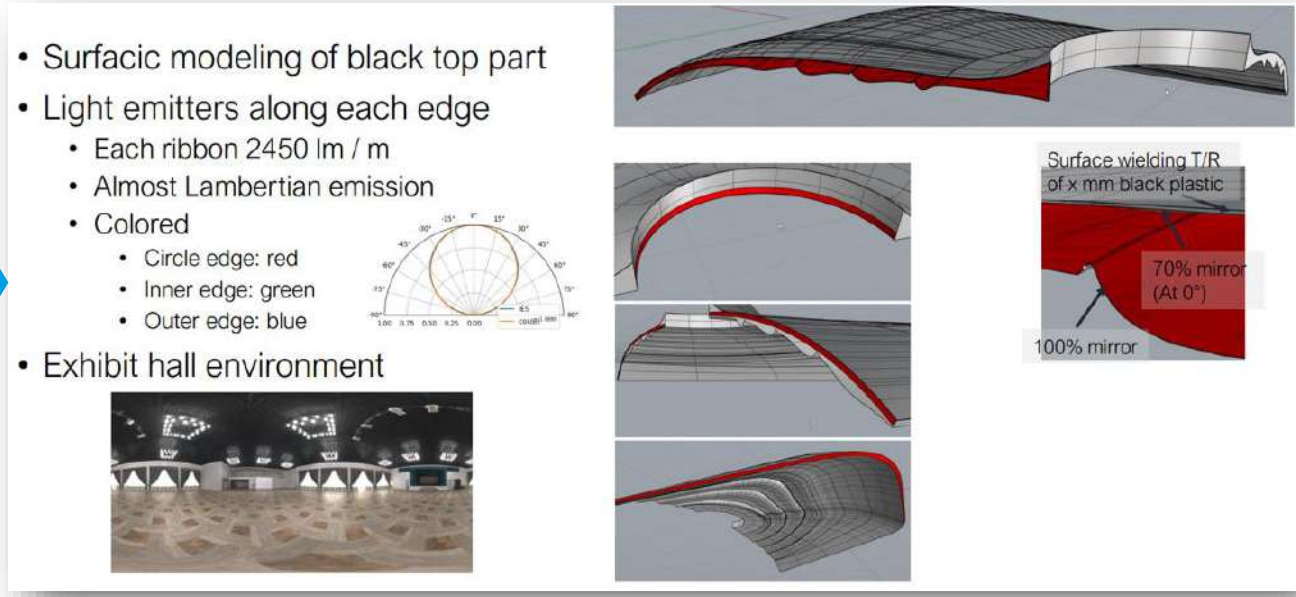
High quality optical data for realistic virtual prototyping of optical effects

Imagio® Optical Material Data – Data source for optical simulation



https://optical-material-data.imagio.covestro.com/

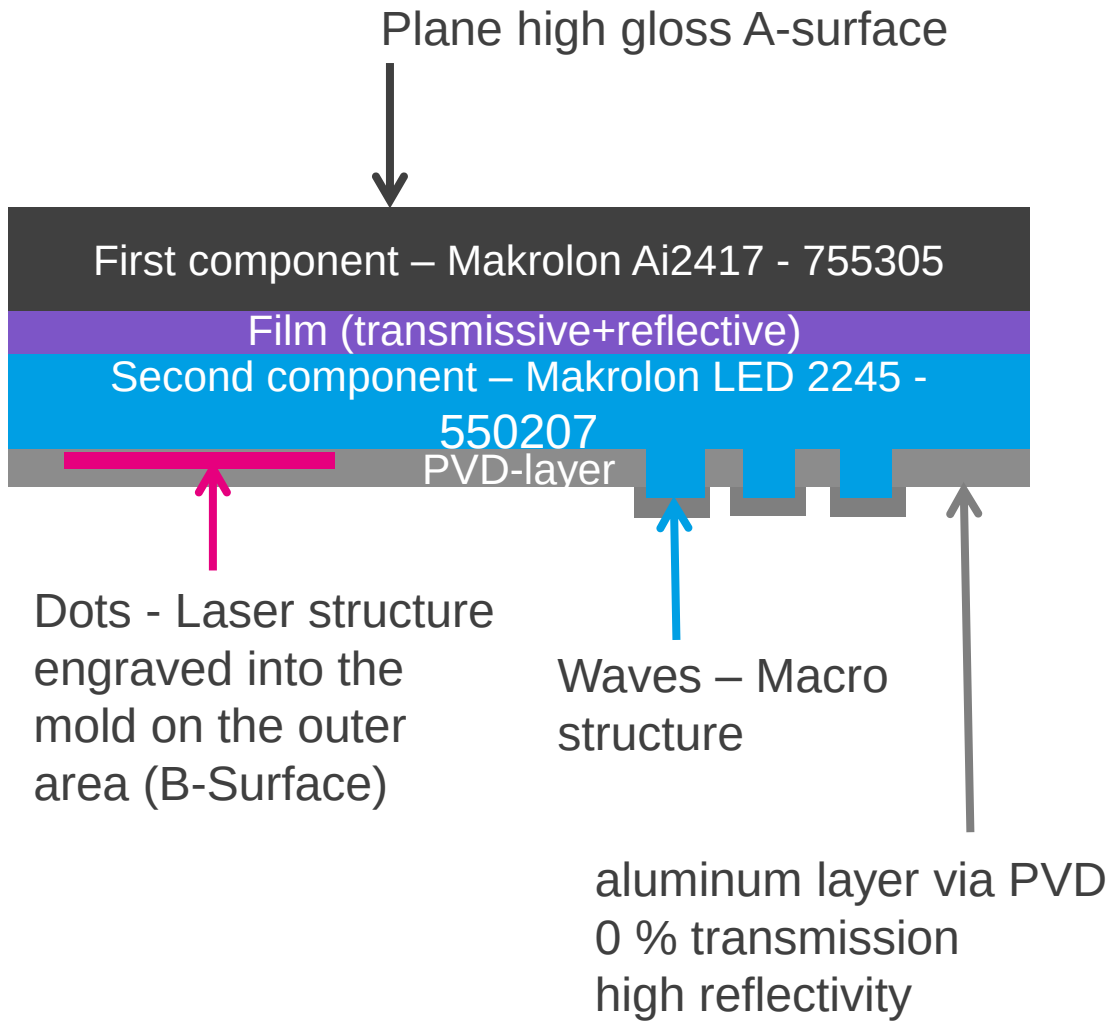
Ocean – Virtual prototyping software by Eclat Digital



PHASE 2

Part Build-up - Details

- Non-illumination appearance: The part presents a piano-black A-surface when unlit, achieved with the first component made of Makrolon Ai2417, special color 755305, with 5% light transmission.
- Invisible structures on the B-surface: Microstructures (dots) are created via laser texturing, while macro structures (waves) result from a high-polished part contour—both remaining non-visible on the B-surface.
- Depth effect via inner design: Perceived depth is generated by mirroring edge-injected light using an over-molded semi-transparent film between the first and second components, complemented by a reflective PVD aluminum layer on the outer B-surface.



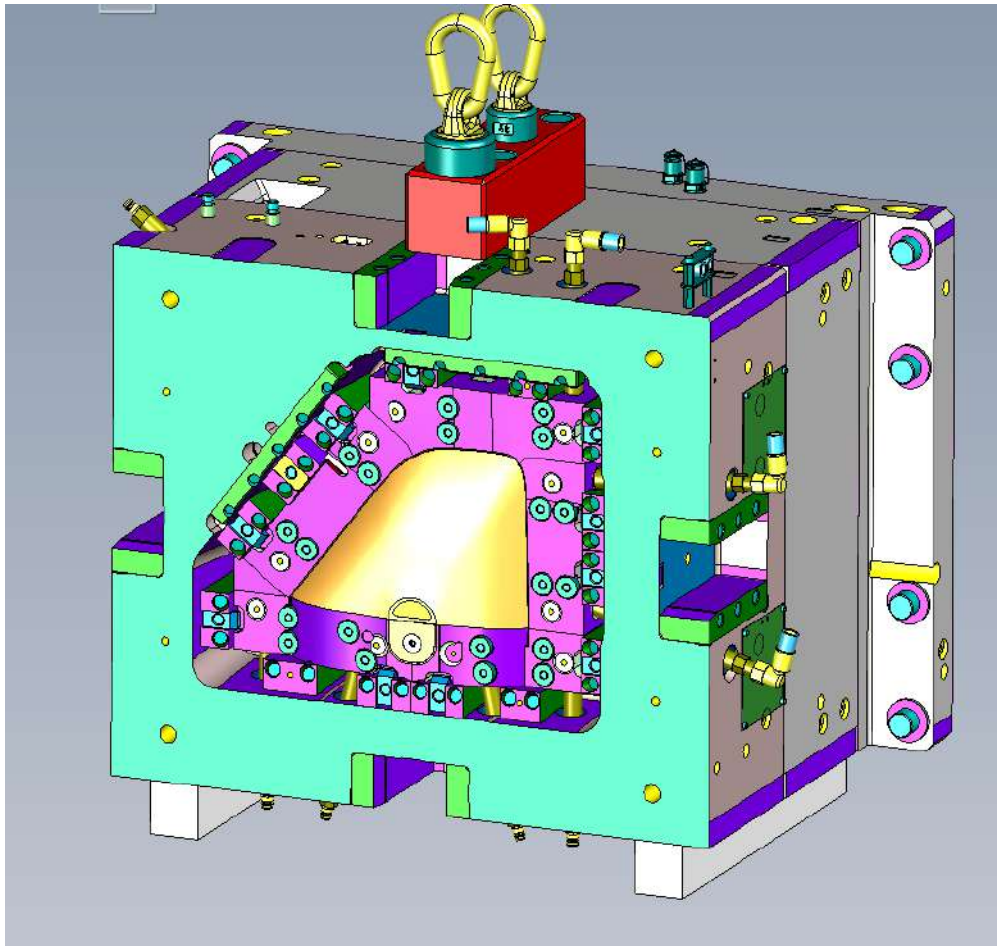
5 steps to the infinity light!

1. Molding of 1st component with film inside the non movable cavity side Makrolon Ai 2417 - 755305
2. Molded component is placed in another cavity for second over molding step
3. Second overmolding of the counter film side Makrolon Ai 2215 - 550207
4. Aluminum PVD Coating (B-surface)
5. Protective coating (UV curing) (A-surface)

Step 1: Mold design of 1st component

Film insert molding with Makrolon® Ai2417 - 755305

- Film is placed inside of the cavity and hold in place by vacuum near the injection gate (b-surface of first component)
- Injection compression molding based on compression frame elements and fixed core
- High gloss polished surfaces
- Hot runner
- Film gate (milled off in post process step)
- Mold steel 1.2342 ESU
- Insert is removable



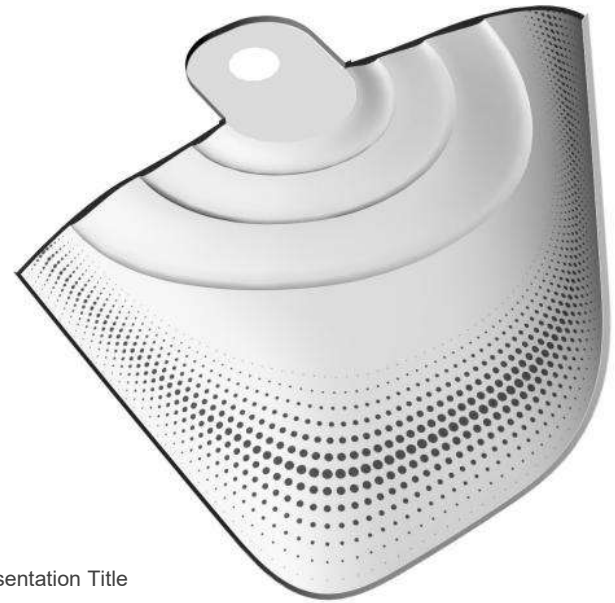
Step 3: Mold design of 2nd component

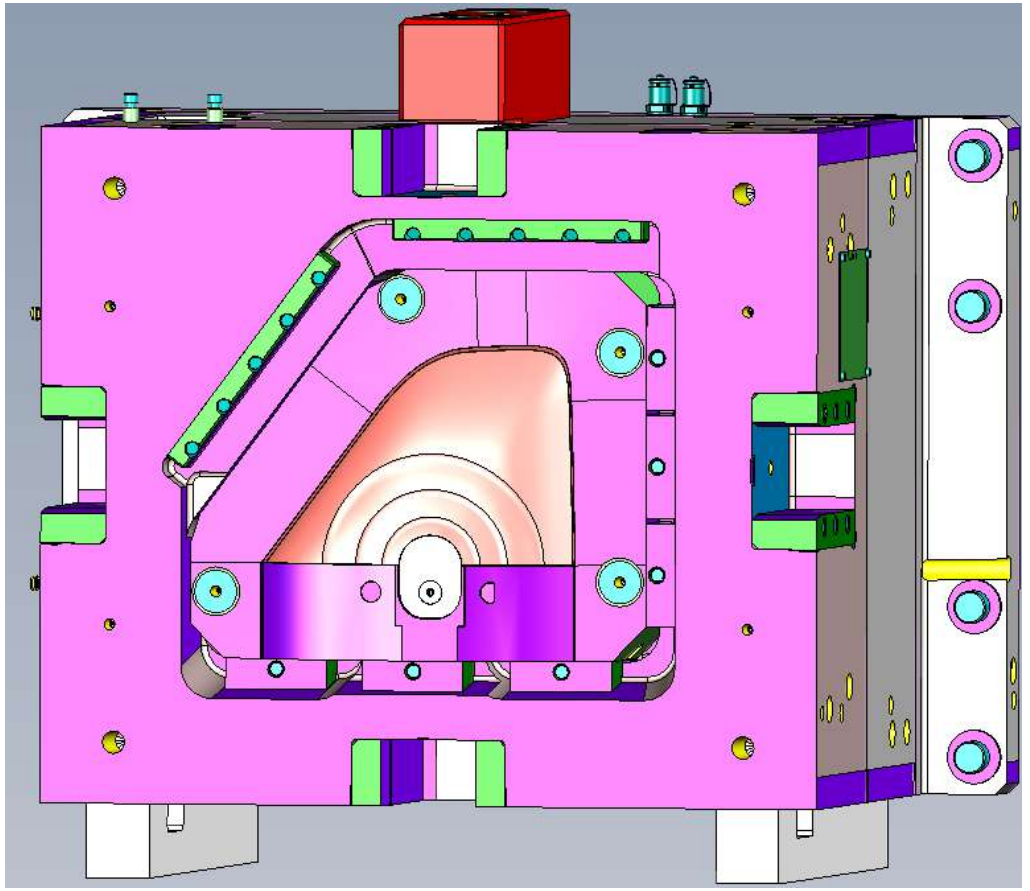
Injection molding of Makrolon® Ai2215 - 550207

- Conventional injection molding

Micro- and macro-structured mold surface for the light out-coupling

- High gloss surface with lasered texture micro elements (dots) on mold cavity by PelPlastic
- Milled high gloss polished macro wave structure





The role of Makrolon® Ai

A polycarbonate for optically demanding interior applications

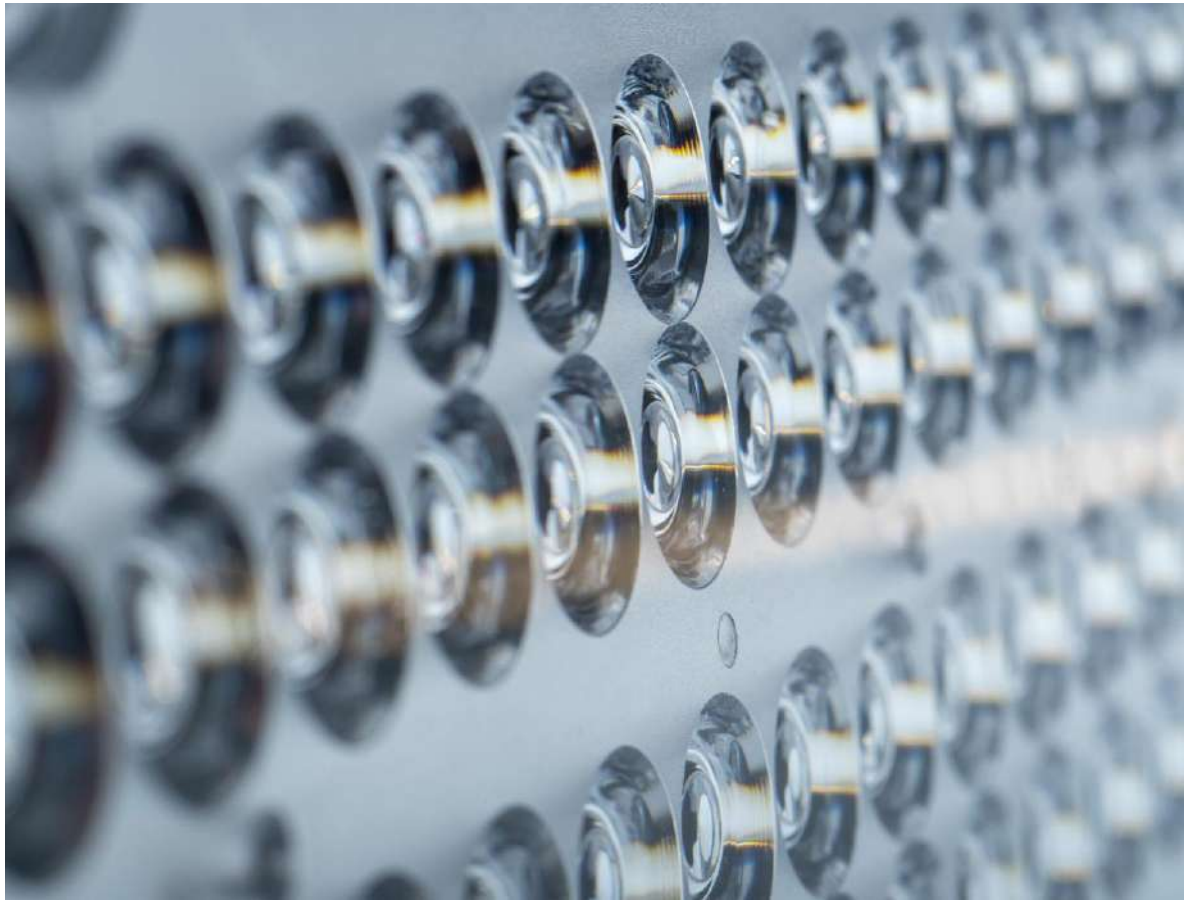
Exceptional Material Purity
No impurities for consistent effects, reducing scrape rate

Customizable color
Neutral gray scalable in light transmission

Thin-Wall Capability
Strength at low thickness

Processing Advantages
Excellent flow for complex geometries

Mono-Material Design
100% recyclable without material separation



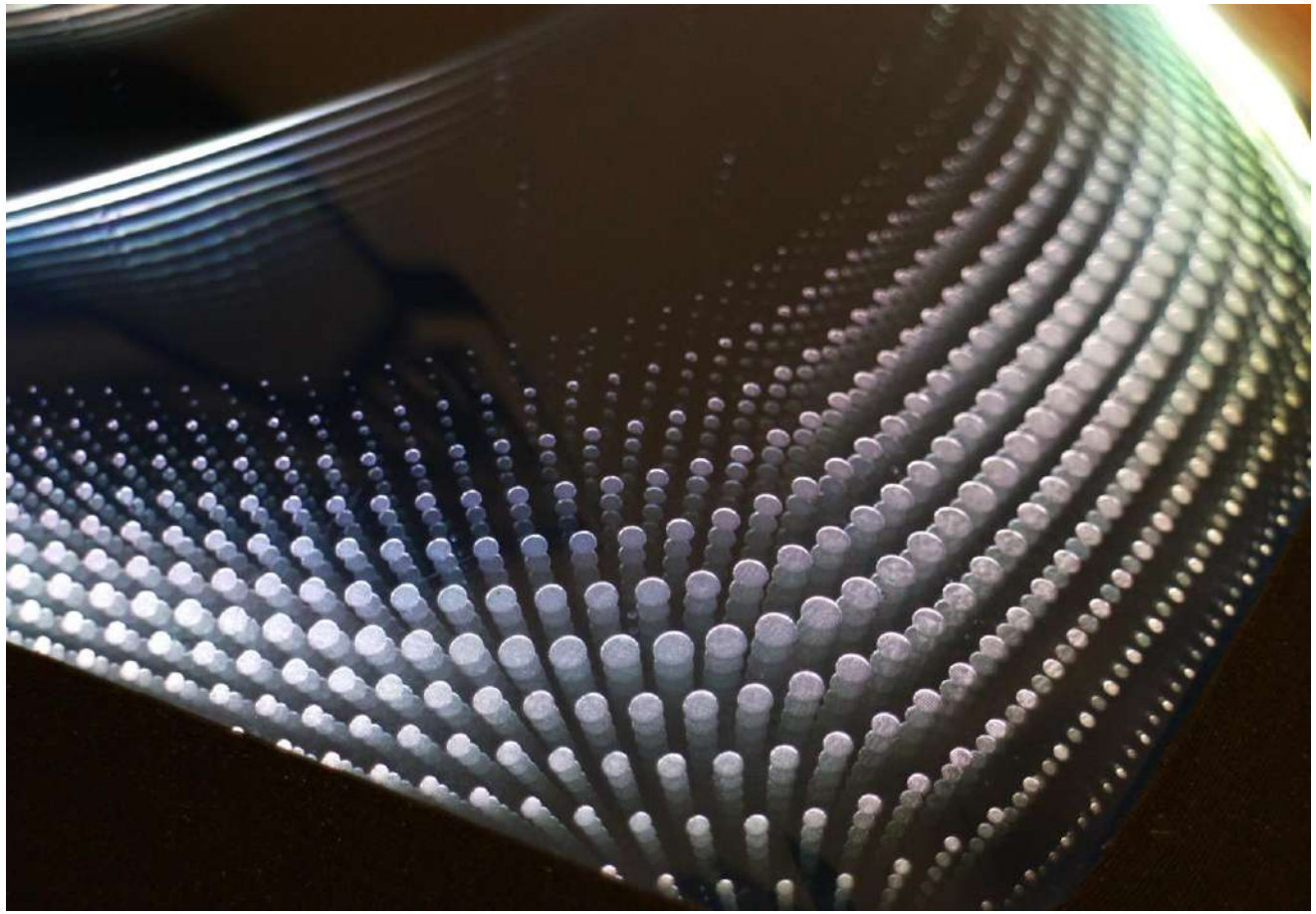
THE RESULT

covestro

The magic happen!

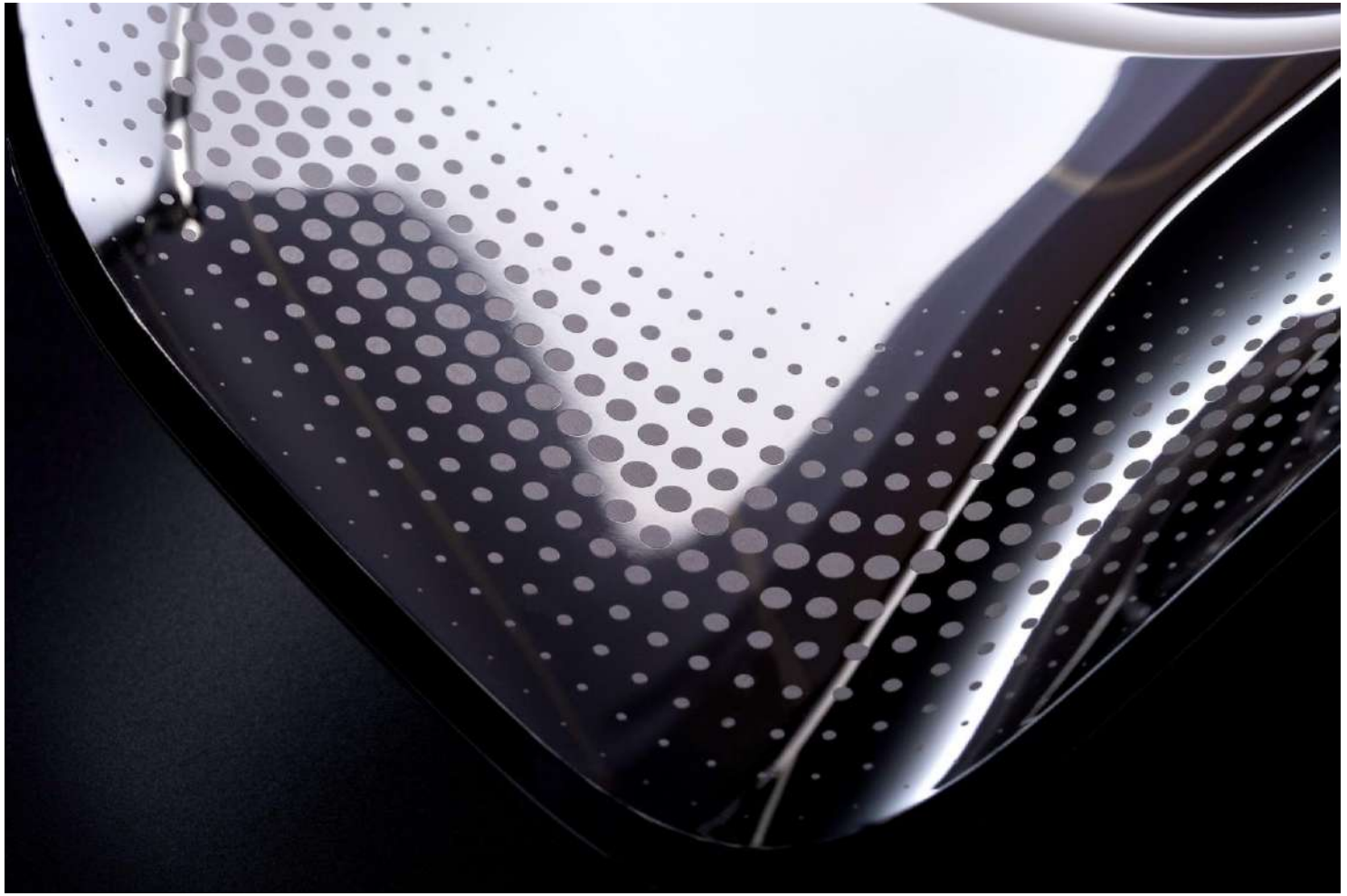
Not illuminated piano black effect

edge lighted infinity effect



Results & Final Demonstrator

Simulation vs. Reality: High Correlation



Value Proposition for Customers

Customer Benefits

- Sustainability: Mono-material design enables full recyclability and supports circular economy goals
- Weight Reduction: Ultra-thin walls reduce component weight by up to 30%, improving vehicle efficiency
- Space Optimization: Compact design frees up valuable space for other vehicle components
- Development Efficiency: Simulation-first approach reduces costs and accelerates time-to-market

Future Applications

"**Sustainable lighting solutions for the vehicles of tomorrow**"

Lightweight Dashboard Components

Space-Efficient Door Panel Lighting

Recyclable Interior Trim

Partner Testimonial

The mono-material approach with Covestro's Makrolon Ai will transform your lighting components. We've achieved the premium infinity effect while reducing weight by 30% and creating a fully recyclable part - a true win for both design and sustainability.

— Miika Heikkinen Northern Design Partner

Results & Final Demonstrator

Simulation vs. Reality: High Correlation

- **Finished Product:** Working infinity light effect demonstrator
- **Visual Accuracy:** Near-perfect match between digital prediction and physical result
- **Efficiency Gains:**
  - 70% reduction in physical prototyping iterations
  - 40% faster time-to-market
  - 30% cost reduction in development process

Cost & Time Benefits

Value Proposition for OEMs

- ~ 60% reduction in development costs
- Faster market introduction
- Reduced tooling investments
- Predictable project timelines
- Lower risk of design failures

Collaborative Innovation

- We provide material expertise and mold simulation capabilities
- OEMs bring design vision and application requirements
- Joint development of customized solutions
- Shared innovation for breakthrough concepts
- Supporting your creative process, not replacing it

Future Vision

"**Enabling Tomorrow's Interior Concepts**"

Digital-First Development
Becomes the new standard for interior lighting

Sustainable Materials
Drive design decisions and brand identity

Personalization
Through programmable lighting experiences

Generated with CoVA

Let's Inspire the Future Together

Call to Action

- Ready to explore your specific applications
- Digital simulation capabilities available now
- Joint development projects welcome
- Supporting your 2026+ interior concepts

Contact: Ciro Piermatteo - ciro.piermatteo@covestro.com

LET'S COLLABORATE ON YOUR NEXT LIGHTING INNOVATION