Exploring new territory for signature lighting to create consumer value

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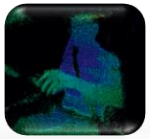
LUMILEDS

Application areas for new value creation

AR HUD

ADAS Interior sensing
(DMS, gesture, occupancy, ...)



AV car indicator lamp

Intelligent Ambient Interior - HMI

AD LiDAR sensing

Rear Signaling Advanced safety

Grille signature illum., welcome light

Exterior car body trim

HD Digital Headlighting

AV Communication Display

ADAS & Park Assist features

Pushing the boundaries of signature lighting

AV signaling

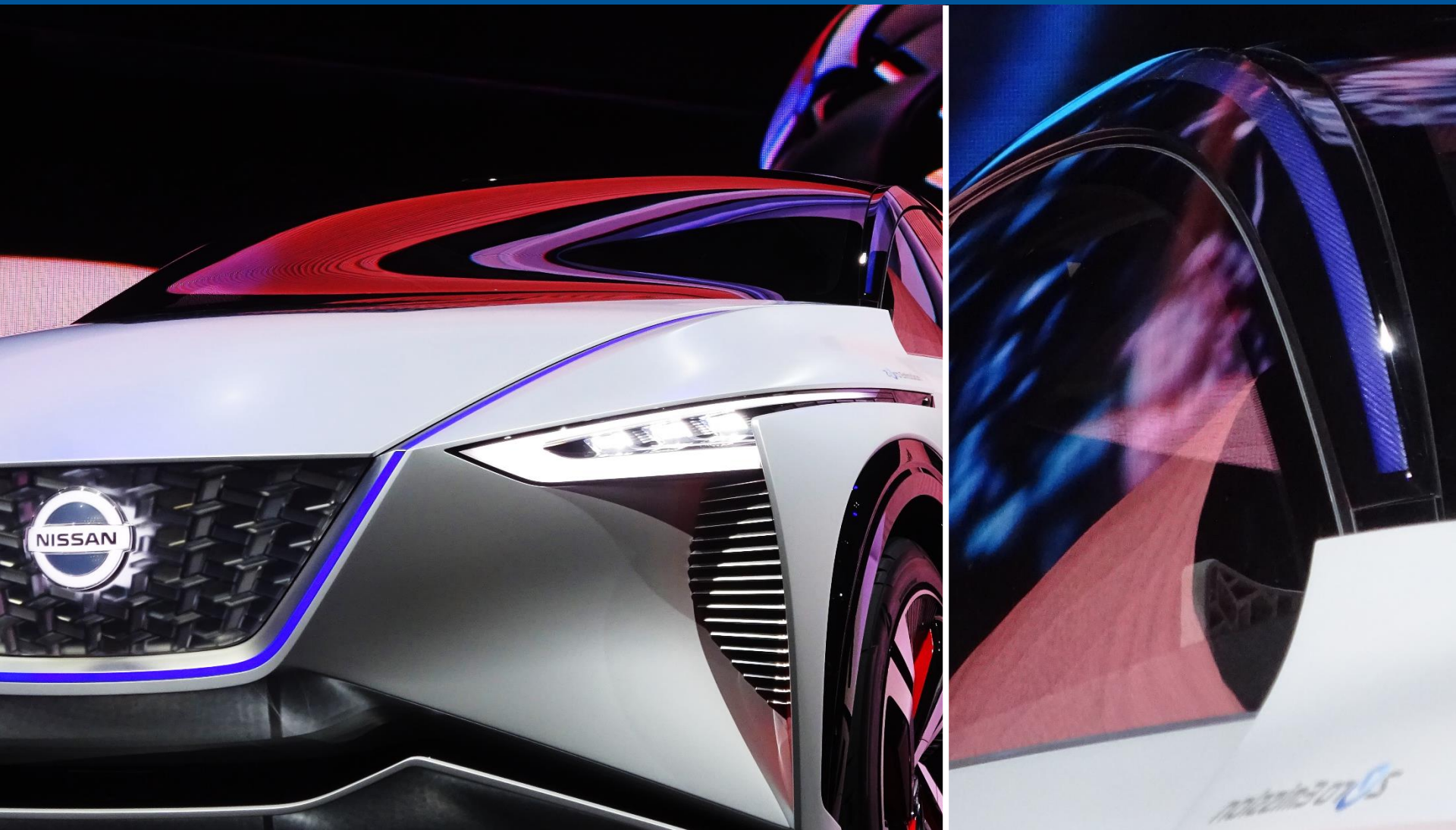
Grille illumination

AV communication

Car body trim lighting

Pushing the boundaries of signature lighting

New Territory #1 : car body trim lighting



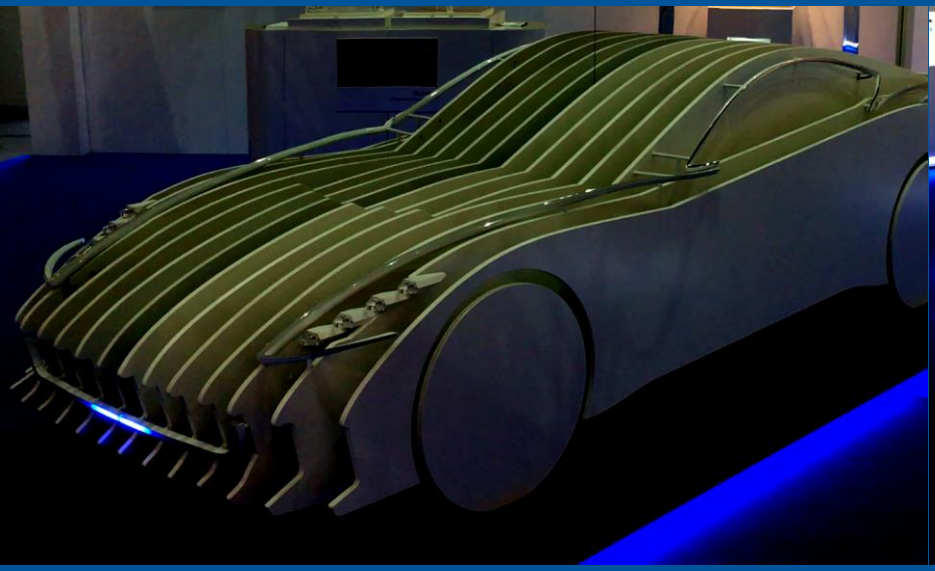
Pushing the boundaries of signature lighting

New Territory #1 : car body trim lighting

Source: Omnium Plastics

Pushing the boundaries of signature lighting

New Territory #1 : car body trim lighting



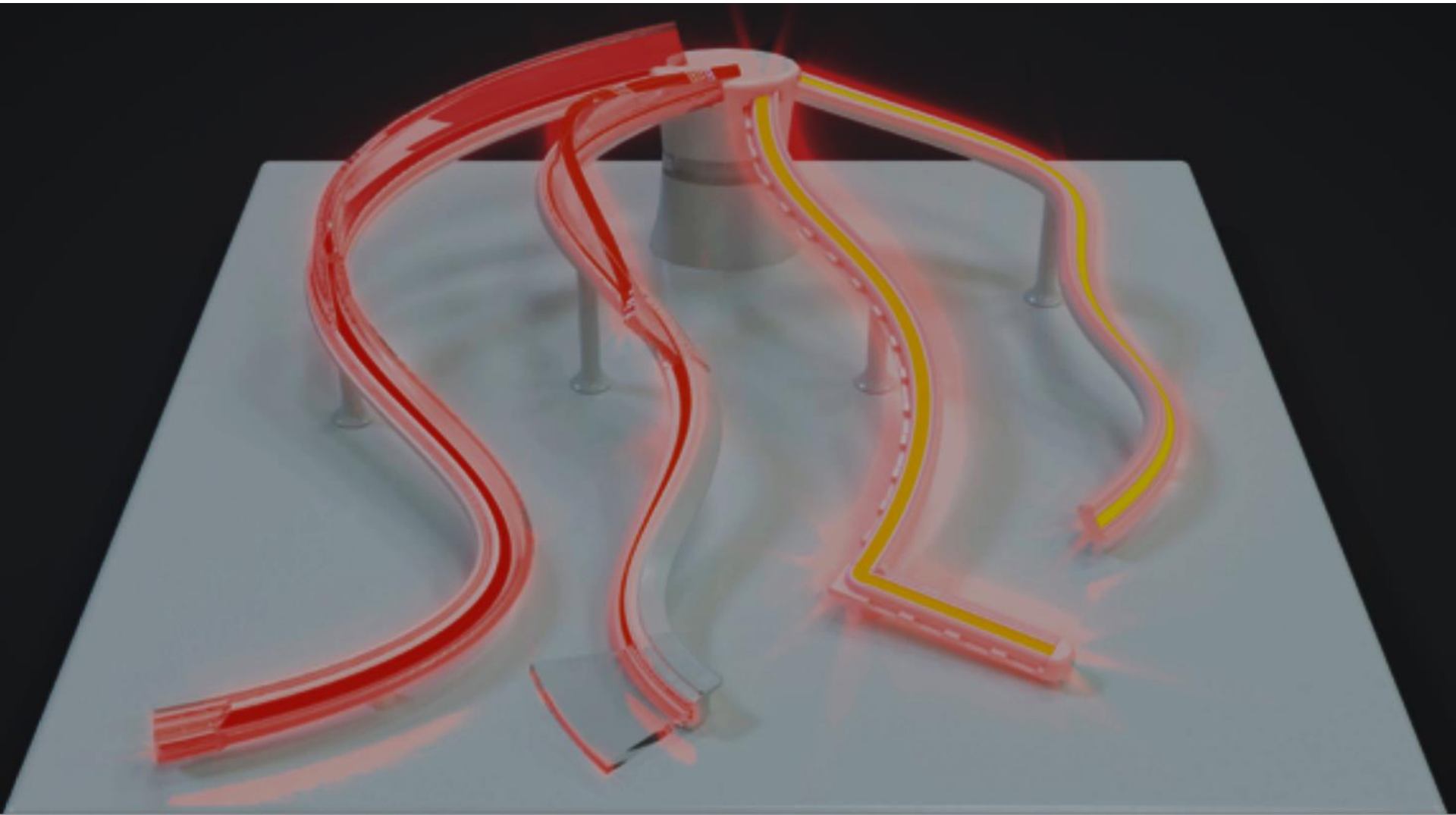
Source: Lumileds

Car body trim lighting

Application requirements for light source

- **Enabing full 3D design freedom**
  - floating, slim, elongated lighting profiles
  - full free standing 3D sculptures
  - continuous wrapping around car body
  - enabling very compact integration design
- **Visual appearance and cosmetic value**
  - highly uniform lit appearance across section length, surface, viewing angle
  - slim illumination profile height, narrow optical gaps, close edges
  - enabling dynamic effects
  - attractive visual appearance, lit and unlit
- **Easy solution integration**
  - self sufficient internal thermal management
  - simplify labor expensive in application integration
  - robust handling in assembly
  - fully automotive qualified

LUXEON 3D LED



LUXEON 3D LED

Product specifications

3D LED is an elongated light source that is bendable in both Y and Z directions and can be twisted in X direction

Optical

Lambertian profile, Light Emitting Area 4 mm

	Homogenity (%)	Wavelength (nm)	Intensity (cd/mm)
Tail	<90	615 (RO)	0.20
		630 (SR)	0.10
Stop	<90	615 (RO)	0.20
Rear Turn	50	592 (Amber)	0.20

Mechanical

Material	Silicone
Max. Length	480 mm
Min. Length	30 mm
Depth x Width	5.5 mm x 8 mm
Min. Bending Radius (y, z)	25 mm
Twisting (x)	90° within 50 mm

Electrical

$V_{forward}$	8 V
$I_{forward\ (480\ mm)}$	960 mA
Power	8 W

Thermal

T_{min}	-40 °C
$T_{max,\ op}$	85 °C
$T_{max,\ storage}$	105 °C

LUXEON 3D LED

Application design rules

3D LED is designed to be applied in sealed lamp (IP5K2). 3D LED can be used for direct emission or in conjunction with optical elements.

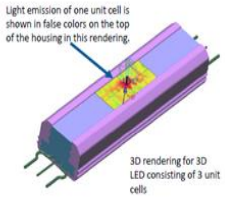
Optical

Verification of optical model

Realization of reference design with all possible geometrical shapes

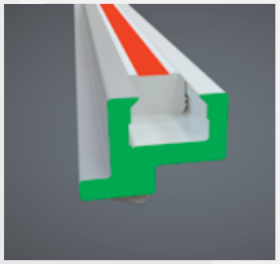
Emission characterization in segments per 3D goniometer

Comparison with optical simulation data

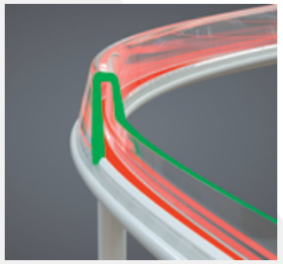


Mechanical

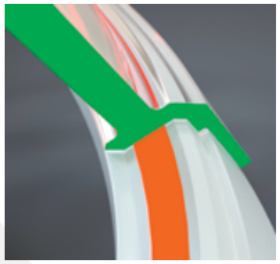
LED can be placed in a holder for attachment in lamp and safe-rding desired structure:



Stand alone structure



In conjunction with optical hollow-body



Light blade

Electrical

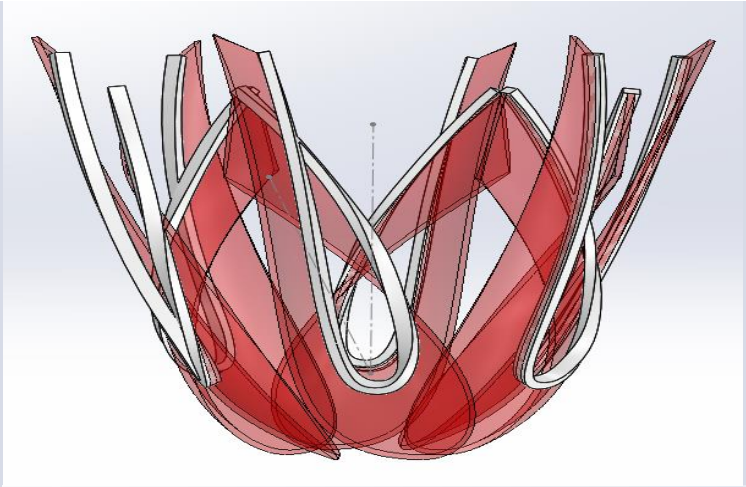
Cable connector at rear side	
Flexible cable length	
Flexible connector choice	
Constant-current electrical driving	

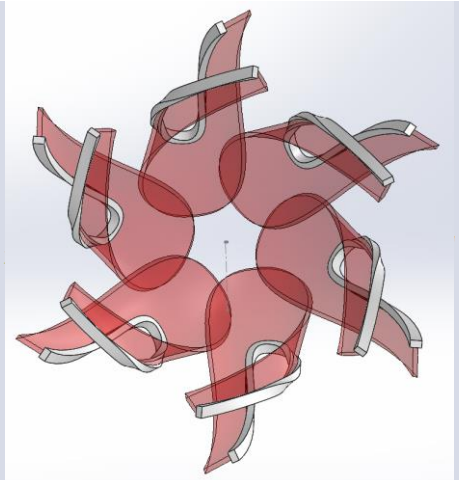
Climate

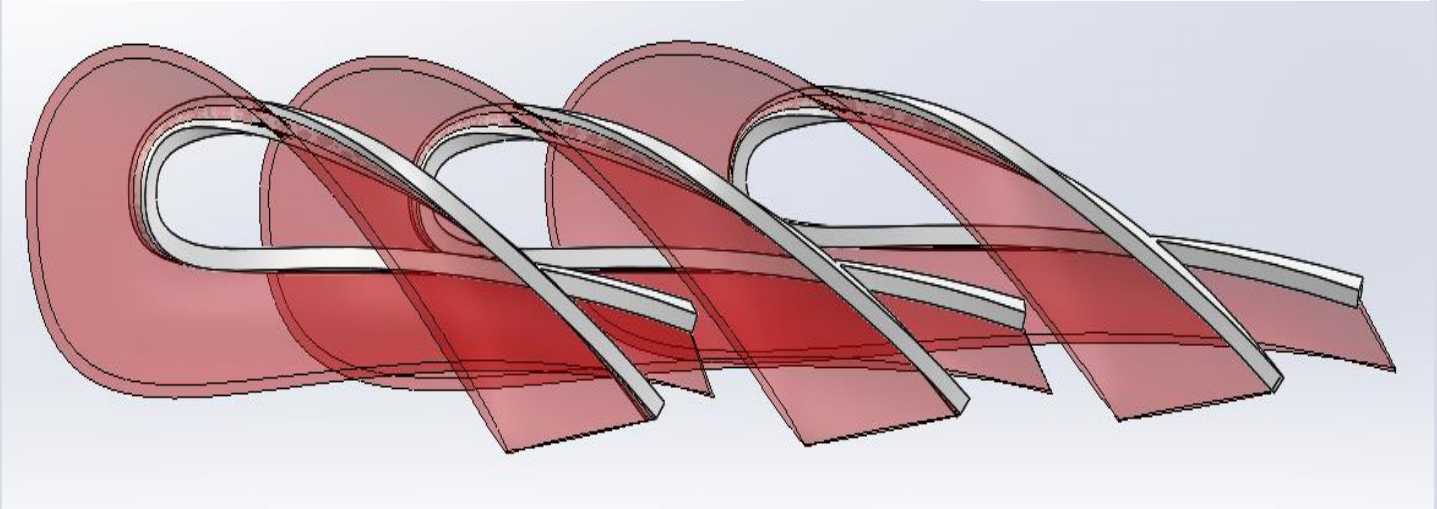
Thermal shock	1.000 cycles	✓
Power temperature	1.000 cycles	✓
Wet heat	1.000 cycles	✓
Damp heat	240 cycles	✓

LUXEON 3D LED

Unleashing your creative designs

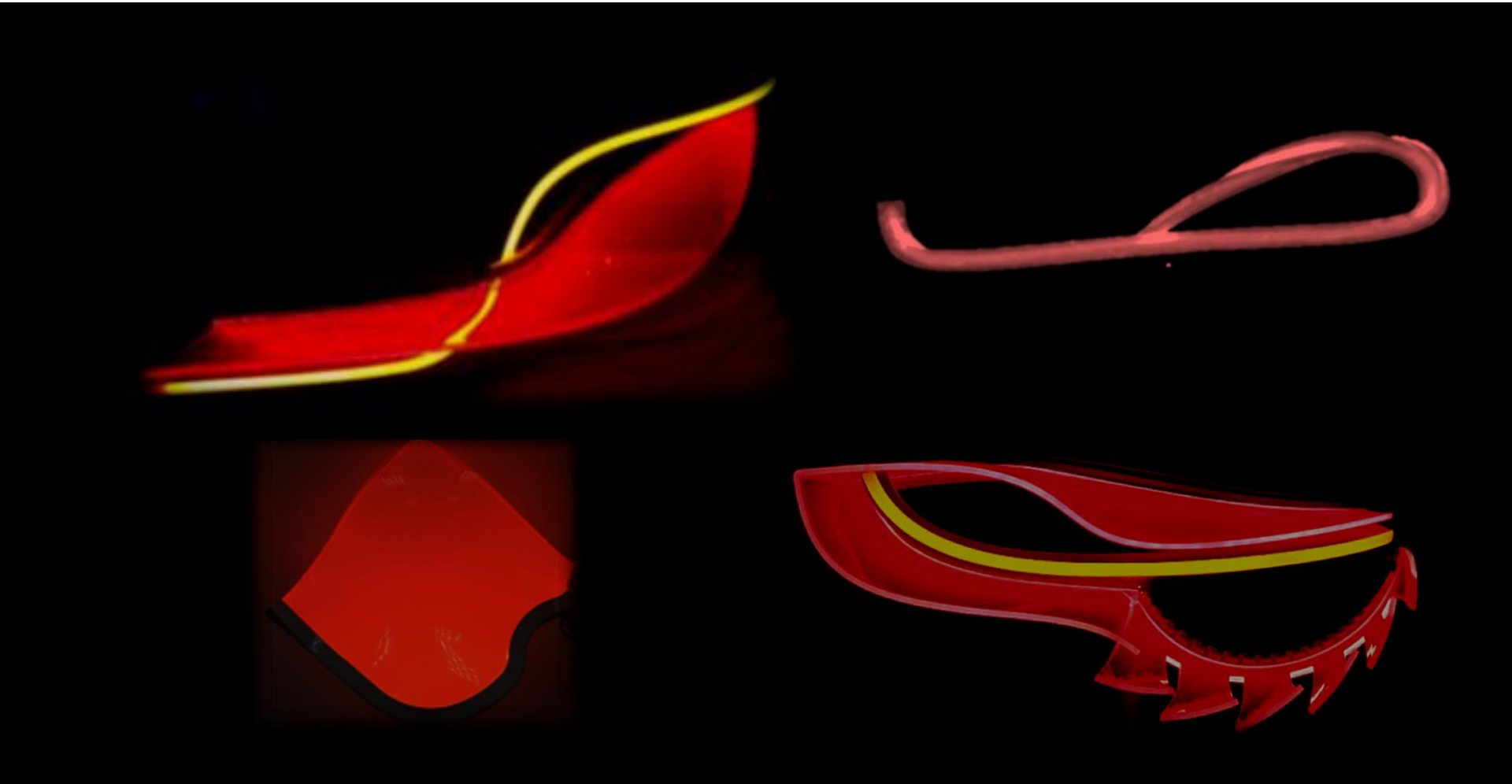






LUXEON 3D LED

Application design demonstrators



Pushing the boundaries of signature lighting

New Territory #2 : grille illumination

Source: Lexus LIT IS concept

Pushing the boundaries of signature lighting

New Territory #2 : grille illumination

Source: Skoda Vision X concept

Pushing the boundaries of signature lighting

New Territory #2 : grille illumination

Source OEM: Hybrid Kinetic, BMW, Audi, Smart, Daimler, PSA DS

Grille illumination

Application requirements for light source

- **Miniaturised lighting elements**
  - higher amount of close spaced emitters
  - small footprint, low package height
  - homogeneous appearance of optical surfaces
  - improved optical efficiency with secondary optics (eg. lightblades)
  - higher luminance (more light from smaller area)
  - good thermal management (low Rth)

- **Multi colors**
  - color range (white, amber, reds, …)
  - portfolio to be expanded over time driven by application needs

- **Scenario lighting**
  - dynamic effects
  - custom matrix addressability solutions

LUXEON Versat

- Small size footprint: 2020 & 3030
- Mix and match colors & flux
- Fit multiple styling needs
- Combined functions
- Enabling dynamics
- Custom on board matrix solutions

LUXEON Versat 2020 and 3030 will be available as a portfolio covering a wide range of colors and flux levels

LUXEON Versat 2020	Cool White	PC Amber	Direct Amber	Red Orange	Red	Super Red
20 mA	-	-	-	release 2019	release 2019	release 2019
50 mA	-	-	release 2019	release 2019	release 2019	release 2019
140 mA	release 2020	release 2020	release 2019	release 2019	release 2019	release 2019

LUXEON Versat 3030	Cool White	PC Amber	Direct Amber	Red Orange	Red	Super Red
150 mA	released	released	-	-	-	-
200 mA	-	-	-	released	released	released
350 mA	released	released	-	release 2018	release 2018	release 2018
700 mA	-	-	-	released	released	released

Pushing the boundaries of signature lighting

New Territory #3 : AV Signaling & Communication

Source: (left) Ford Transit Connect
(right) Daimler Cooperative Car

Pushing the boundaries of signature lighting

New Territory #3 : AV Signaling & Communication

Source: Omnium Plastics; Smart Bumper concept

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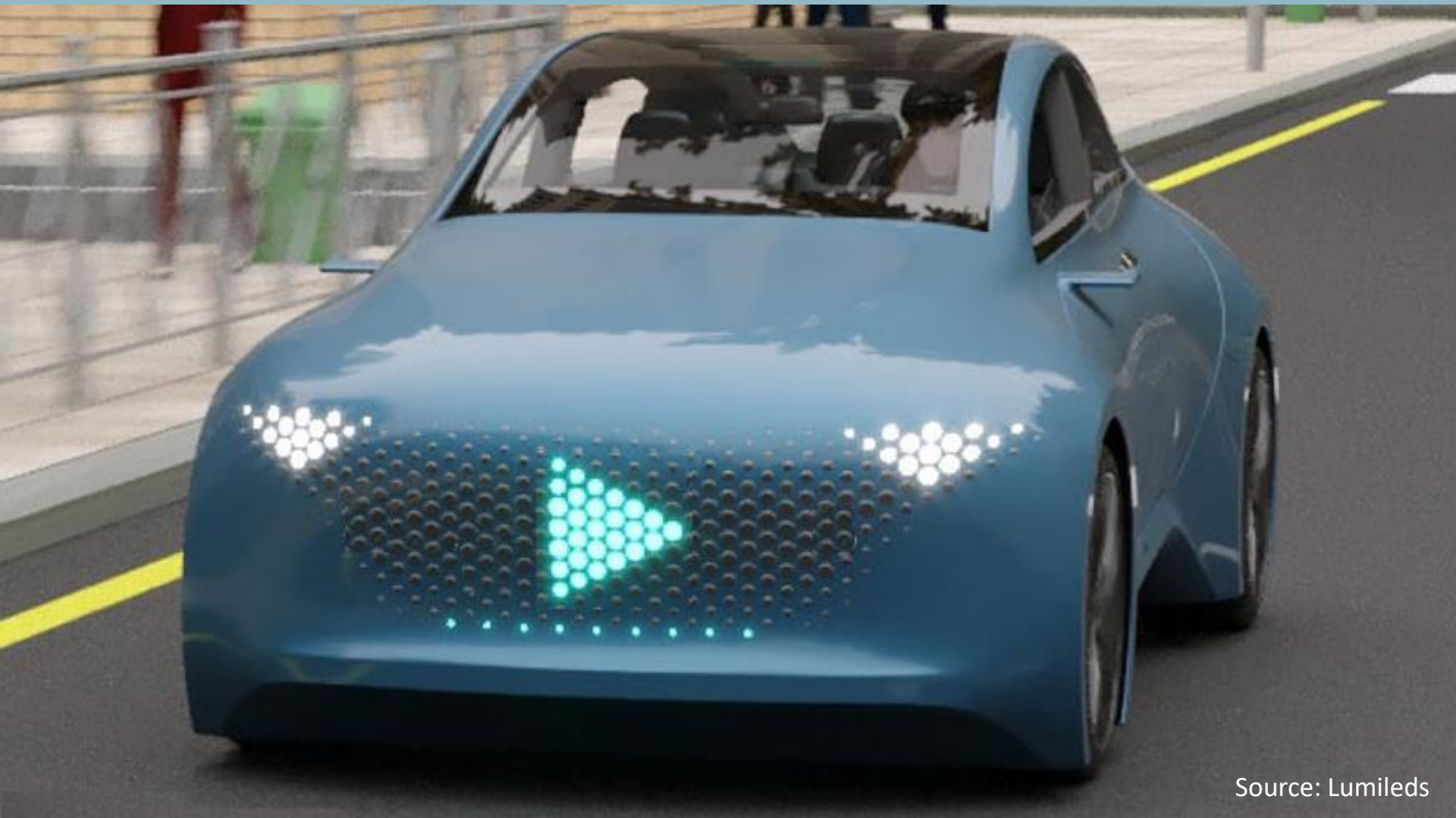
Pushing the boundaries of signature lighting

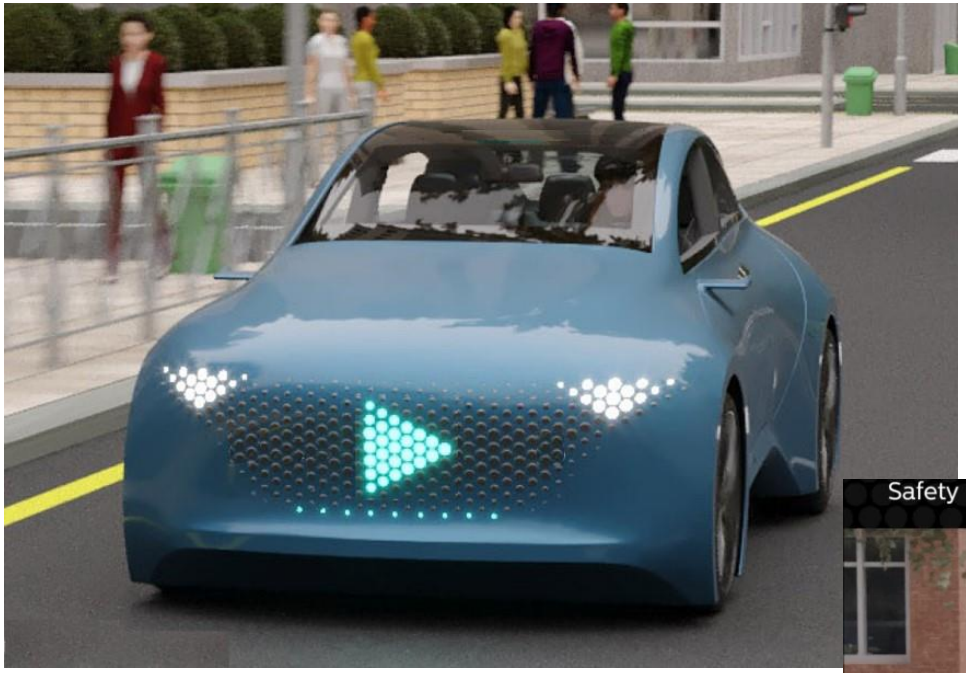
New Territory #3 : AV Signaling & Communication



Source: Lumileds

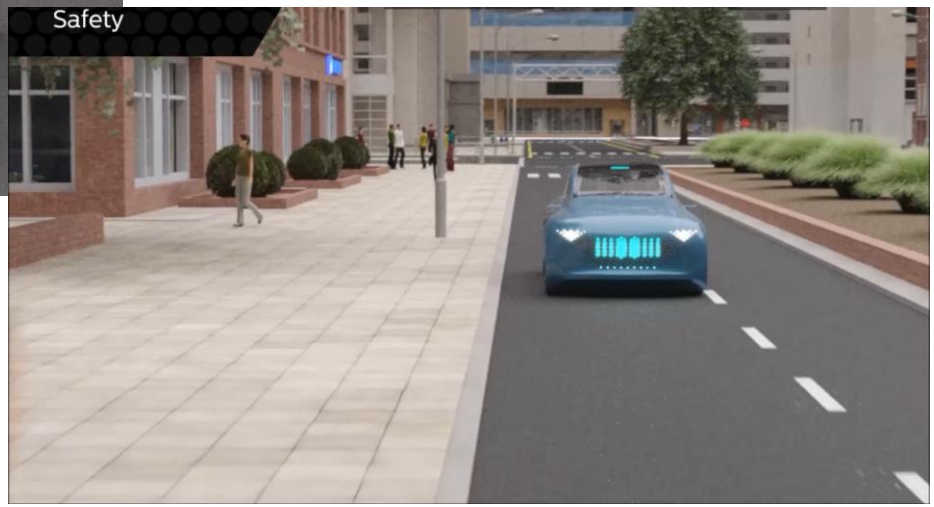
AV Signaling & Communication

Creating a new visual language to interact between car to human



Key Requirements

- Intuitive
- Fast
- Unambiguous
- Culture and language independent



AV Signaling & Communication

Ongoing studies regarding

Many studies ongoing
AVIP
Ghost Driver
CityMobil2
Duke-Display
ISO(Ford)
interACT
NHTSA "AV Intent"
CLEPA-LSS
…

@ different organisations
SAE
ISO
GTB
CLEPA – LSS
OICA
…

@ regulators & governments
U.S. DOT
NHTSA
UNECE
- WP 29, ITS
- WP.1

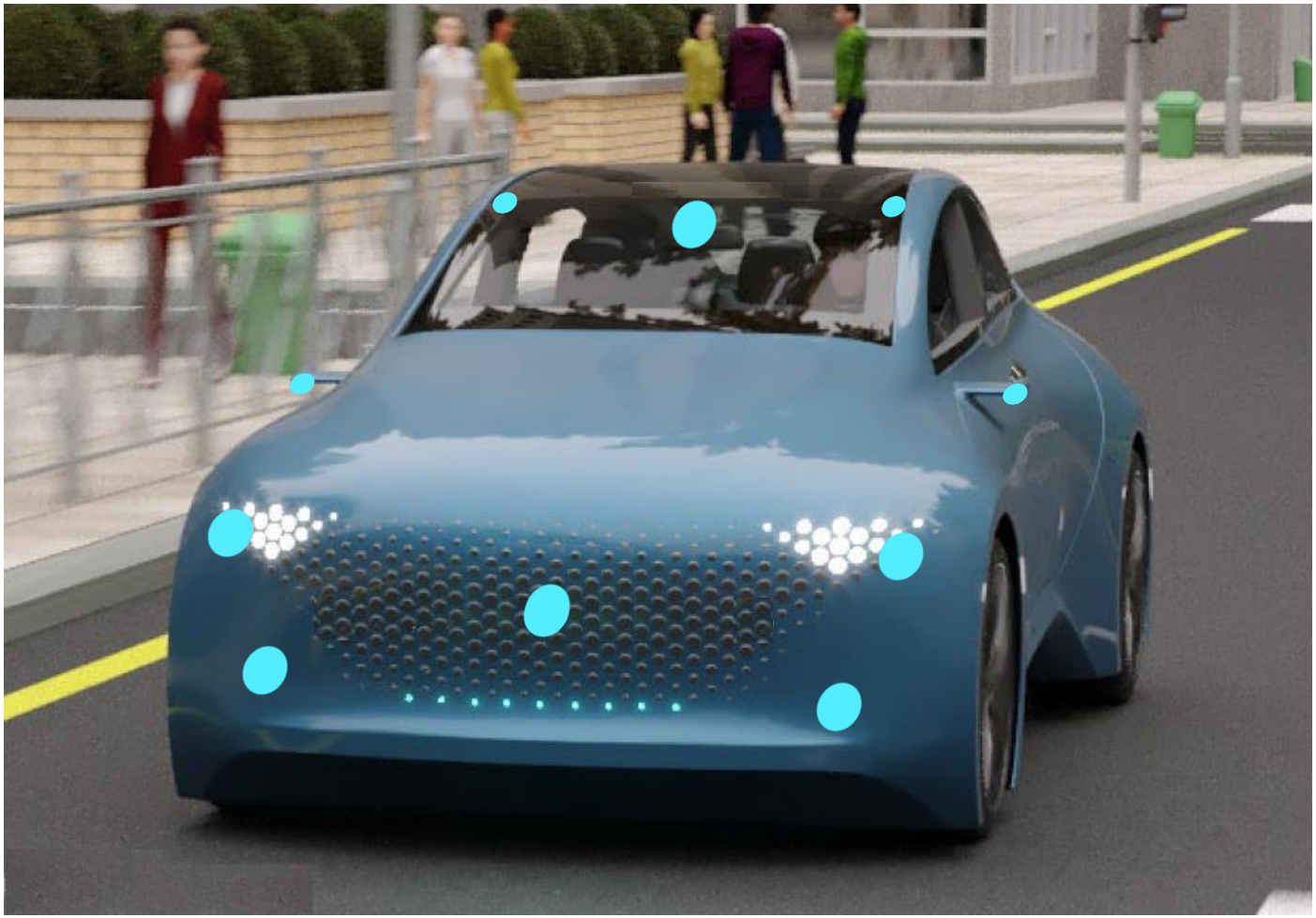
GRVA, GRE
Germany
…

A lot of further application validation studies still to be done to come to a safe and sound conclusion, based on a common understanding of base principles:

- ADS signal lighting needs to be developed **across industry as harmonized standard** between US and Europe
- Significant enhancement of **road safety** is the **primary objective**
- **Vulnerable road users** are of key interest
- Clearly indicate and **distinguish ADS driving status** (e.g. auto vs. manual; yielding,…)

AV Signaling & Communication

Many application specific attributes to be investigated



Application attributes

- Brightness
- Color
- Position
- Size
- Visibility angle
- Dynamics
- Discrimination
- Uniqueness
- User acceptance
- …

AV Signaling & Communication

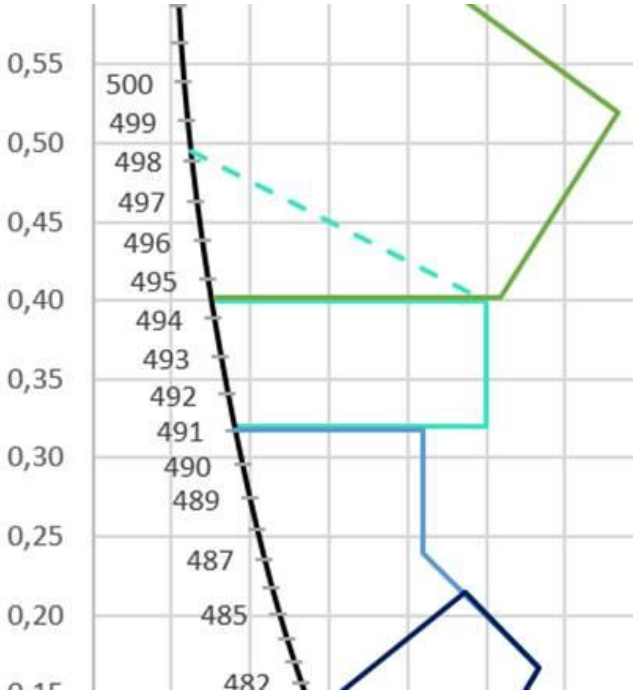
Exploration of the color CYAN, as potential color for ADS indicator lamp

AV Signaling & Communication

Exploration of the color CYAN, as potential color for ADS indicator lamp

- Color specification for ADS indicator lamp under discussion and ongoing:
  - SAE : <+/-2nm (rectangle)
  - GTB : +/- 3.5nm (+ dotted triangle)

- Enabling light source technology (epitaxy, phosphor, packaging proliferation) under assessment to best accommodate proposed application color specification requirements



Take aways

- New application territory for signature lighting,
  creating customer value for safer and smarter lighting!

- State of the art light source technology,
  enabling never before possible application solutions!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